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ABSTRACT

A series of studies were conducted to modify the General Aptitude Test Battery (GATB) and the Minnesota Importance Questionnaire (MIQ) for use with mentally retarded individuals. Modification of the GATB consisted of eliminating answer sheets, increasing practice, individual administration, untimed administration, removal of verbally loaded items, and simplifying test instructions and practice problems. None of these modifications significantly changed the test performance of the mentally retarded subjects. Modification of the MIQ involved rewriting the item stems at a readability level which was understandable to mentally retarded individuals. Form S, the revised 17-scale MIQ, was found equivalent to the standard MIQ in terms of profile similarity and, for 11 of 17 scales, equivalent means and standard deviations. Individual differences in measured abilities and needs among the mentally retarded were found to approximate those of the non-mentally retarded. Applicability of the Theory of Work Adjustment, utilizing the GATB and Form S MIQ in assessing work personalities, is indicated for mentally retarded individuals in the borderline and, to a lesser extent, the mild categories. (Author)

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ASSESSING THE WORK PERSONALITIES OF MENTALLY RETARDED ADULTS

RD-2568-P

Final Report
September 1970

Department of Psychology
University of Minnesota

EE031 9926

Significant Findings for Rehabilitation (and Social Service) Workers

1. Multifactor assessment of vocational abilities is feasible for the mentally retarded.* The General Aptitude Test Battery (GATB) is an appropriate tool for this purpose and can be used without further modification.

2. In the multifactor assessment of vocational abilities, the use of "wrong" scores (number of incorrectly answered items), "speed" scores (number of items attempted), and "accuracy" scores (ratio of correctly answered items to total attempted) can yield information not given by conventional "right" (number right) scores. The vocational significance of these scores has yet to be determined, however.

3. Form S, a revision of the Minnesota Importance Questionnaire (MIQ) developed in this project, can be used in the multifactor assessment of vocational needs of the mentally retarded. Form S was shown to be understandable to the mentally retarded and equivalent (in terms of profile similarity and for many scales equivalent means and variances) to the standard form MIQ.

4. Individual differences in measured abilities and needs among the mentally retarded were observed to approximate those among the non-mentally-retarded. Furthermore, the patterns of relationships among abilities and among needs observed for the mentally retarded were similar to those for the non-mentally-retarded. A wide variety of work personality types can therefore be expected among the mentally retarded. A more individualized approach to the vocational rehabilitation of the mentally retarded than is currently practiced would seem to be indicated.

5. Use of the GATB and Form S of the MIQ will enable the utilization of Occupational Aptitude Patterns (OAPs) and Occupational Reinforcer Patterns (ORPs) in the exploration of possible vocational choices for the mentally retarded. In such exploration, prediction of work adjustment, as formulated in the Theory of Work Adjustment, can be made on the basis of the correspondence of GATB and MIQ scores with OAPs and ORPs, respectively. GATB-OAP correspondence can be used to predict satisfactoriness, and MIQ-ORP correspondence to predict satisfaction. Hence, occupational possibilities can be found for which the mentally retarded would be predicted to be both satisfactory and satisfied.

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* "Mentally retarded" refers to individuals with IQs between 1 and 3 standard deviations below average or those classified as "borderline" or "mild". The more severely retarded mentally are not included in this reference.

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Assessing the Work Personalities of Mentally Retarded Adults

RD-2568-P

Final Report
September 1970

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Table of Contents

Page

Acknowledgments ii

Abstract iv

Introduction 1

Background 1

Statement of the problem 2

Review of relevant literature 3

Organization of this report 4

Methodology 6

GATB Study 1 12

GATB Study 2 24

GATB Study 3 34

GATB Study 4 38

MIQ Study 1 46

MIQ Study 2 57

MIQ Study 3 62

MIQ Study 4 66

MIQ Study 5 69

MIQ Study 6 72

MIQ Study 7 75

MIQ Study 8 80

Summary of Results 89

Discussion and Implications 93

Summary 98

References 102

Appendixes 105

Abstract

A series of studies were conducted to modify the General Aptitude Test Battery (GATB) and the Minnesota Importance Questionnaire (MIQ) for use with mentally retarded individuals. Modification of the GATB consisted of eliminating answer sheets, increasing practice, individual administration, untimed administration, removal of "verbally loaded" items, and simplifying test instructions and practice problems. None of these modifications changed significantly the test performance of the mentally retarded subjects. Modification of the MIQ involved rewriting the item stems at a readability level which was understandable to mentally retarded individuals. Form S, the revised 17-scale MIQ, was found equivalent to the standard MIQ in terms of profile similarity and, for 11 of 17 scales, equivalent means and standard deviations. Individual differences in measured abilities and needs among the mentally retarded were found to approximate those of the non-mentally retarded. Patterns of relationships among abilities and among needs for the mentally retarded were similar to those of the non-mentally retarded. Applicability of the Theory of Work Adjustment, utilizing the GATB and Form S MIQ in assessing work personalities, is indicated for mentally retarded individuals in the "borderline" and, to a lesser extent, the "mild" categories.

Introduction

Background

Project Grant No. RD -- 2568 -- P, entitled "Assessing the Work Personalities of Mentally Retarded Adults", with Professors Lloyd H. Lofquist and Rene V. Dawis of the University of Minnesota as principal investigators,[1] was initiated on July 1, 1967 and completed on June 30, 1970. This project had its origins in the implications that the Theory of Work Adjustment (Dawis, England & Lofquist, 1964; Dawis, Lofquist & Weiss, 1968) had for disability and work. In a monograph under this title (Disability and Work, Lofquist et al., 1964); it was stated that:

"Proceeding from (the Theory of Work Adjustment), the approach to disability and work . . . is based on the premise that, for purposes of vocational rehabilitation counseling, a discussion of the influence of a disabling condition is more meaningful when emphasis is placed on the effect of the trauma in job-relevant abilities. This includes the effect of the trauma on an individual's vocational needs when changes in needs are accompanied by significant changes in job-relevant abilities. These statements suggest that describing the impact of a disabling condition on an individual in work-adjustment terms may not be the same as describing it in medical diagnostic terms." (p.3)

Elsewhere in the same monograph, the authors list the study of the work personalities of mentally retarded individuals as an important research problem: "The individual differences in the abilities and needs of mentally retarded individuals should have significance for work adjustment. The mentally retarded individual, just as the normal individual, has a unique work personality, and his own work adjustment possibilities." (Lofquist, et

[1]Professor George W. England was a third principal investigator during the first project year (1967-68).

al., 1964, p. 10).

Statement of the Problem

The basic objective, then, of this project was to make a contribution to work personality assessment of adult mentally retarded individuals. Specifically, in the context of the Theory of Work Adjustment, this objective translated to the assessment of the work-relevant abilities and needs of mentally retarded individuals. The basic premise, to reiterate, was that individual differences in abilities and needs exist among even mentally retarded individuals, to the degree that it would be advantageous to capitalize on such individual differences in dealing with the adjustment to work of these individuals. This premise, it should be noted, runs counter to the stereotypy that commonly prevails in current thinking about work possibilities for the mentally retarded. It is the viewpoint of this project that knowledge of individual differences in work-relevant abilities and needs of mentally retarded persons cannot but enlarge the range of work adjustment possibilities for such persons beyond the pitifully narrow range now available or even considered appropriate.

In planning for the project, it was felt that a desirable goal would be to develop the tools which would enable the utilization of the predictive model implicit in the Theory of Work Adjustment. This model makes use of the concept of correspondence between work personality and work environment as the key predictor of work adjustment. From this point of view, two of the most useful descriptions of the work personality currently available are the United States Employment Service's General Aptitude Test Battery (GATB) and The Work Adjustment Project's Minnesota Importance Questionnaire (MIQ). These instruments are useful because of the large number of jobs described in GATB

terms as Occupational Aptitude Patterns (OAPs; U.S. Department of Labor, 1966) and in MIQ terms as Occupational Reinforcer Patterns (ORPs; Borgen, et al., 1968). Thus, it was reasoned, if instruments equivalent to the GATB and the MIQ could be developed for the mentally retarded, this would allow utilization of the existing OAP - ORP technology in the assessment of work adjustment possibilities for mentally retarded persons.

The specific problem, then, to which the project was addressed, was: Can such instruments be developed for use with mentally retarded individuals that can yield work personality information equivalent to the GATB and the MIQ? Because of the tremendous time and resources necessary to undertake development of an ability test battery such as the GATB, it was decided to attempt to modify or reconstruct the GATB itself for use with the mentally retarded. A less ambitious, but nevertheless expensive and difficult, undertaking decided on was the construction of an MIQ form that would be understandable to mentally retarded individuals and at the same time equivalent (in information yield) to the regular MIQ.

Review of the Relevant Literature

Most studies on the mentally retarded, when discussing their vocational abilities, take one of two extremes: discussion is confined to either IQ (general intelligence) assessment or specific work skills (as in workshop or work sample evaluations). The middle ground of multiability or multiaptitude assessment is rarely touched. A singular exception is Tizard, O'Connor and Crawford's (1950) study of GATB performance by 104 adolescent and adult "high grade mental defectives".

Besides studies using IQ (which remains the single best predictor of job success; see McNemar, 1964, and Ghiselli, 1955), other studies on the mentally

retarded have included the assessment of finger dexterity (Cantor & Stacey, 1951; Clausen, 1966; Tobias & Gorelick, 1960; Elkin, 1967; Wagner & Hawver, 1965; and Parnicky & Kahn, 1963); manual dexterity (Murray, 1956; Cantor, 1960; Wagner & Hawver, 1965; and Distefano, Ellis & Sloan, 1958); spatial relations (Page, 1933; Murray, 1956; and Tizard & Loos, 1954); and mechanical ability (Frandsen, 1935; Parnicky & Kahn, 1963; and Elkin, 1967). As the preceding listing indicates, studies on the vocational abilities of mentally retarded individuals are meagre in number. More studies have been published on their physical abilities (e.g., static strength, strength of grip, running speed, beam walking, and even reaction time), but rarely, if at all, were the findings reported in a vocational context. Studies concerning workshop and work sample evaluations (e.g., Kelstoe, 1961; Appel, Williams & Fishell, 1962; Tobias, 1960; and Ladas, 1961) were seen by some as the most promising avenue to the vocational assessment of mentally retarded individuals, but the limitations of such evaluations have since become apparent (Sakata & Sinick, 1965). Besides being quite expensive, they have demonstrated little validity for vocational prediction beyond that attainable by less expensive ability testing. This discouraging result may in part be due to the unstandardized and unsystematic manner in which such evaluations are carried out and, in turn, evaluated.

The literature on the topic of vocational needs of mentally retarded individuals is even more meagre than that on vocational abilities. Parnicky and Kahn (Parnicky & Kahn, 1963; Parnicky, Kahn & Burdett, 1965), in a major effort at developing a vocational interest measure for use specifically with this population, constructed a picture inventory of jobs representing seven occupational areas in the men's form and five occupational areas in the women's form. The Geist Picture Interest Inventory (Geist, 1959) has been used with mentally retarded individuals (Magary, 1961). Interviews were

used to get at vocational preferences by Cohen & Rusalem (1964) and Erdman (1957) and Gorelick (1966, 1967).

As the preceding review of the literature indicates, knowledge about the work personalities of mentally retarded individuals is rather limited and in need of much more research.

Organization of this Report

This Final Report is organized into seven parts: 1) Introduction, 2) Methodology, 3) Summary of Results, 4) Discussion and Implications, 5) Summary, 6) References, and 7) Appendixes. The major portion of the report is found in the Methodology part. Because this project consisted of a series of separate experiments and studies, the Methodology part is organized around the separate studies. There are two groups of studies reported, GATB studies and MIQ studies, highlighting the focus of this project on these two instruments. Each study is reported in its entirety, the study report consisting of three sections: Purpose, Method, and Results, with the Method section generally further subdivided into four subsections (Subjects, Instruments, Experimental Design, and Analysis). The individual study results are integrated in the Summary of Results part. All other parts of the report follow closely the Guide for Preparing Final Reports (1968).

Methodology

A series of studies, some of them experimental and others of the field type, was undertaken with two major objectives in mind: (1) to modify the GATB for use with the mentally retarded; and (2) to develop an MIQ form that was understandable to the mentally retarded and at the same time equivalent (psychometrically) to the regular MIQ.

Four studies were conducted in connection with the first objective. These are reported under the following headings:

GATB Study 1. Answer sheet and practice effects on ability test performance

GATB Study 2. Group vs individual and speeded vs non-speeded administration, and ability test performance

GATB Study 3. Influence of verbal loading on ability test performance

GATB Study 4. Difficulty of instruction and practice, and ability test performance.

Eight separate studies were conducted in pursuit of the objective of developing an MIQ for use with the mentally retarded. These are reported as:

MIQ Study 1. Item development

MIQ Study 2. Estimation of item understandability

MIQ Study 3. Equivalence of Form M and Form P

MIQ Study 4. Wording revision of nine scales

MIQ Study 5. Equivalence of Form M, Form MRev and Form P

MIQ Study 6. Understandability of Form M, Form MRev and Form P

MIQ Study 7. Construction of Form S

MIQ Study 8. Equivalence of Form S and Form P

Each of the GATB and MIQ studies is reported separately as a complete study, i.e., with its own Purpose, Method, and Results section. The Method section of each study is further subdivided into subsections for Subjects, Experimental Design (for experiments) or Procedure (for field studies) and Analysis.

Before proceeding with these individual study reports, the groups of mentally retarded subjects participating in these studies deserve more detailed description.

The mentally retarded subjects in these studies came from two different population sources. One subject source was the sheltered workshops in Minnesota. Individuals in these sheltered workshops are described as "functionally retarded." Subjects from a few sheltered workshops participated in more than one study. The largest single group of sheltered workshop subjects participated in GATB Study 4 (N = 167). These individuals were located in seven sheltered workshops throughout the state and appeared to be representative of the total group of sheltered workshop subjects.

IQ scores were available for 122 of these 167 individuals. Since these scores were obtained from different intelligence tests,[1] scores were converted to T-scores (mean = 50, SD = 10) using developmental means and standard deviations. Where a number of scores were available for a single individual, only the highest T-score was recorded. Table 1 shows the distribution of IQ and IQ T-score for these 122 mentally retarded subjects. Categorization according to the official terminology of the American Association on Mental Deficiency is also included.

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[1]Among the tests used as sources of IQ information were: Stanford-Binet Intelligence Scale, Wechsler Adult Intelligence Scale, Wechsler-Bellevue Intelligence Scale, Wechsler Intelligence Scale for Children, Otis Quick-Scoring Mental Ability Tests, California Test of Mental Maturity, Lorge-Thorndike Intelligence Tests, Peabody Picture Vocabulary Test, Army General Classification Test, and the Ammons and Ammons Quick Test.

Table 1

Distribution of mentally retarded subjects from sheltered workshops, by classification, IQ, T-score, and sex

Classification	IQ	IQ T-Score	Number	
			Male	Female
	85 & up	40 & up	12	8
Borderline	70-84	30.0-39.9	16	19
Mild	55-69	20.0-29.9	20	25
Moderate	40-54	10.0-19.9	7	15
Severe	25-39	0.0-9.9		
Profound	25	0.0		
Total Number			55	67
Mean (IQ T-score)			30.7	27.7
SD (IQ T-score)			11.3	9.0

[a]From Heber, R. Modifications in the manual on terminology and classification in mental retardation. American Journal of Mental Deficiency , 1961, 65, 499-500.

As Table 1 indicates, two-thirds of the subjects can be categorized as 'mild' or "borderline". About one-sixth (16%) actually had IQs within the normal range (IQ 85 and up). The remaining individuals, slightly more than one-sixth, were classified as "moderate". Average IQ was approximately 2 SDs below the mean. A sex difference in average IQ T-score was observed ($P < .01$), with the females having the lower average IQ.

The second subject source was the Minnesota Division of Vocational Rehabilitation (DVR), which had contracted with the Work Adjustment Project for a continuing program of testing and vocational assessment of its clients. DVR clients referred to the Work Adjustment Project are administered the GATB, the MIQ, the Strong Vocational Interest Blank, the Minnesota Vocational Interest Inventory, the Minnesota Multiphasic Personality Inventory and the Gates Reading Tests. Some of the DVR clients are classified as "mentally retarded" (based on a variety of information, e.g., school records, IQ tests, institutional history, etc.). Many of these mentally retarded DVR clients participated as subjects in several of the studies. Table 2 presents data on the GATB test performance of these subjects and comparative data for non-retarded DVR clients who were also referred to the Work Adjustment Project for testing, as well as the GATB general working population norms for the same tests.

Table 2 shows that the DVR retarded sample had test means which were usually 1 to 1 1/2 SDs below the general working population mean. Exceptions to this observation include the means for Arithmetic Reasoning, Mark Making, Place, Turn and Disassemble, for which the DVR retarded sample's means were about 2 SDs below the general working population mean. (In contrast, the DVR non-retarded group had test means equivalent to those of the general working population, except for the dexterity tests on which

Table 2

Means and standard deviations of GATB B-1002 B test scores

for DVR retarded, DVR non-retarded and GATB norm groups, by tests

	GATB Test	DVR retarded[a]		DVR non-retarded[b]		GATB[c] norm	
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
1.	Name Comparison	25.1	11.4	42.1	14.4	43.7	15.9
2.	Computation	8.9	5.6	20.3	6.2	23.1	6.7
3.	Three-Dimensional Space	9.1	5.2	17.4	5.8	16.8	6.5
4.	Vocabulary	7.0	4.7	19.0	8.4	19.1	10.1
5.	Tool Matching	19.7	7.7	24.9	7.3	29.1	6.6
6.	Arithmetic Reasoning	4.2	3.0	10.7	3.4	11.4	3.5
7.	Form Matching	15.3	5.9	23.6	7.9	23.9	6.9
8.	Mark Making	49.0	13.0	63.2	11.7	69.5	10.3
9.	Place	73.7	14.0	81.9	12.7	89.8	8.6
10.	Turn	79.8	12.3	88.9	12.4	100.8	9.6
11.	Assemble	21.7	6.7	25.4	5.2	28.3	4.6
12.	Disassemble	21.4	3.4	25.5	5.2	29.5	3.7

[a] N=53 except for Vocabulary and Arithmetic Reasoning (for both of which N=34)

[b] N=50 Both DVR groups (retarded and non-retarded) consisted of clients who were referred to the Work Adjustment Project for testing and vocational assessment.

[c] N=4,000 (the GATB General Working Population Sample). See U.S. Department of Labor, Bureau of Employment Security. Guide to the use of the General Aptitude Test Battery, 1962, pp. 23, 25.

the DVR non-retarded test means were lower.) The DVR retarded sample had a higher average IQ than the previously described sheltered workshop sample of mentally retarded individuals, the difference between the two samples was about one-half standard deviation.

The data in Tables 1 and 2 are given to obviate the necessity of describing each sample of mentally retarded individuals participating in each of the 12 studies reported on the following pages. Instead, the source of the mentally retarded subjects is given for each study.

A final question that may be raised about the mentally retarded subjects concerns the choice of these particular populations (sheltered workshop and DVR). These populations were chosen for study since this particular project, an outgrowth of the Work Adjustment Project, focused on work and work adjustment; therefore, that segment of the mentally retarded population that had work potential and/or was vocationally rehabilitable was of primary interest. It is, of course, conceded that "work potential" and "vocational rehabilitability" are matters of degree and not of kind. This point is reflected in the range of ability--and of vocational needs--to be found in the groups of mentally retarded subjects in the different project studies.

GATB Study 1

Answer sheet and practice effects on ability test performance

Purpose

A study was designed to examine the effects of two test format variables upon the performance of persons of various ability levels. The two test format variables were: 1) the use of a separate answer versus no separate answer sheet; and 2) the use of a standard number of practice problems versus double the standard number of practice problems.

It was hypothesized that the elimination of separate answer sheets would help persons to answer more items correctly and fewer items incorrectly. It was also hypothesized that elimination of separate answer sheets would help mentally retarded individuals more than non-retarded individuals. With regard to practice problems, it was hypothesized that increasing the number of practice problems would help persons to answer more items correctly and fewer items incorrectly. Such modifications in test format were hypothesized to aid mentally retarded individuals more than others.

Method

Subjects--Four groups of subjects, representing four levels of general ability, participated in the study: (a) 68 mentally retarded (MR) persons from two sheltered workshops; (b) 137 high school (HS) students enrolled in mechanical arts curricula; (c) 77 General College (GC) students in introductory psychology classes; and (d) 384 College of Liberal Arts (CLA) students in introductory psychology classes.

Instruments--Four GATB B-1002B tests were used in the present study: Name Comparison, Computation, Vocabulary, Tool Matching. Each of the tests

 was administered in the standard item sequence and under standard time limits.

Standard instructions were used in all experimental conditions, with some slight modification when IBM answer sheets were not used.

Experimental design--Subjects from each of the four ability groups were assigned at random to one of four experimental conditions: (a) No extra practice with separate answer sheet; (b) No extra practice with no separate answer sheet; (c) Extra practice with separate answer sheet; and (d) Extra practice with no separate answer sheet. Once assigned to a given experimental condition, a subject received all four GATB tests under that experimental condition.

Instructional and practice problems for no-extra-practice conditions were as given in the GATB tests. For extra-practice conditions, standard GATB instructional and practice problems were kept in their original order and a like number of extra practice problems of similar difficulty were added at the end of the standard practice problems. That is, the number of practice problems was doubled for the extra-practice conditions.

The standard IBM answer sheet was employed in two experimental conditions. Standard GATB instructions were left unchanged for these conditions. The two no-answer-sheet conditions, on the other hand, involved a slight modification of test instructions. These conditions required examinees to answer items by circling response alternatives in the test booklet.

Analysis--Right scores and wrong scores were used as two separate dependent variables. An individual's right score for a given test was the total number of items he answered correctly; his wrong score was the total number of items he answered incorrectly.

The two independent variables--the number of practice problems (no extra practice versus extra practice) and answer sheet (separate answer sheet versus no separate answer sheet)--constituted fixed, completely crossed factors for a 2 x 2 analysis of variance, which was run for each GATB test and each ability group. In addition to these analyses, 2 x 2 x 3 analyses of variance were run, using ability level as a classification (blocking) variable. It should be pointed out that these 3-way analyses were not entirely legitimate since it was impossible to assign subjects at random to ability groups.

Results

Right and wrong score means and standard deviations for the four experimental conditions, four GATB tests, and four ability groups are given in Tables 3 and 4.

Table 3 shows that the MR group invariably had the lowest mean right score for any GATB test under any experimental condition. However, it often was as variable within the group as the three other groups. The MR group was the least variable of the four groups for the Vocabulary test (in 3 of the 4 experimental conditions) and for the Name Comparison test for the no-extra-practice conditions. Otherwise, it is worth noting that the spread of individual differences for the MR group on the three non-verbal subtests was as large as that for the other groups.

Table 4 shows some interesting results. The MR group had the (expected) highest mean wrong score in only 8 of the 16 possible instances. The HS group had the highest mean wrong score in 5 instances and the GC group in 3 instances. In 10 of 16 instances, the MR group was the most variable,

Table 3

Pight score means and standard deviations
by treatment combination

GATB Test	No Extra Practice				Extra Practice			
	Answer Sheet		No Answer Sheet		Answer Sheet		No Answer Sheet	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
MR Group	(N=19)		(N=16)		(N=17)		(N=16)	
Name Comparison	25.7	6.97	32.4	11.82	32.3	17.38	30.5	13.42
Computation	12.8	4.17	15.6	7.35	14.8	5.82	14.1	6.32
Vocabulary	9.7	5.06	7.1	3.28	8.4	4.01	8.2	3.82
Tool Matching	21.0	7.51	23.1	9.51	23.8	6.85	26.1	8.11
HS Group	(N=31)		(N=32)		(N=38)		(N=36)	
Name Comparison	48.9	13.72	53.3	11.95	49.2	8.00	60.2	16.23
Computation	23.3	6.32	19.0	5.72	23.7	4.35	23.0	5.82
Vocabulary	22.2	8.93	14.0	4.94	21.4	6.66	19.8	7.51
Tool Matching	31.4	8.66	35.7	5.44	32.8	7.33	35.9	6.31
GC Group	(N=19)		(N=17)		(N=24)		(N=17)	
Name Comparison	49.1	12.73	60.8	14.04	56.8	11.15	71.0	12.52
Computation	24.6	2.87	27.7	4.97	26.6	5.43	29.0	5.73
Vocabulary	20.9	2.88	28.9	7.72	23.7	4.37	26.1	5.94
Tool Matching	32.5	4.86	34.2	5.22	35.0	5.47	39.4	6.63
CLA Group	(N=93)		(N=100)		(N=99)		(N=92)	
Name Comparison	64.2	13.26	85.3	16.03	64.8	11.59	84.2	16.32
Computation	28.8	4.68	33.2	4.93	29.7	4.46	32.4	4.77
Vocabulary	31.0	5.87	33.7	9.67	31.7	5.14	36.0	6.83
Tool Matching	36.4	6.32	40.4	5.92	34.8	5.23	39.8	6.10

Table 4

Wrong score means and standard deviations
by treatment combination

GATB Test	No Extra Practice				Extra Practice			
	Answer Sheet		No Answer Sheet		Answer Sheet		No Answer Sheet	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
MR Group	(N=19)		(N=16)		(N=17)		(N=16)	
Name Comparison	6.7	6.76	12.1	14.52	3.7	2.52	5.1	3.40
Computation	4.7	3.48	3.8	2.67	2.6	3.16	3.9	3.21
Vocabulary	10.5	7.71	13.4	12.14	9.4	6.32	10.5	9.95
Tool Matching	4.1	5.66	3.4	6.03	1.8	1.92	1.4	1.36
HS Group	(N=31)		(N=32)		(N=38)		(N=36)	
Name Comparison	3.7	2.94	5.0	5.39	3.3	2.69	4.4	3.32
Computation	2.6	2.16	4.8	4.42	3.0	2.30	3.3	3.63
Vocabulary	7.3	3.64	19.0	8.73	10.3	6.09	17.5	7.16
Tool Matching	1.7	2.96	1.8	1.37	2.7	4.99	1.3	1.66
GC Group	(N=19)		(N=17)		(N=24)		(N=17)	
Name Comparison	4.3	3.94	3.7	3.53	3.8	3.47	4.6	3.47
Computation	2.2	1.96	2.3	1.93	3.0	2.03	2.5	1.91
Vocabulary	7.4	4.09	13.7	6.62	9.5	4.95	15.6	6.86
Tool Matching	2.6	3.53	1.9	1.89	1.8	1.79	1.8	1.95
CLA Group	(N=93)		(N=100)		(N=99)		(N=92)	
Name Comparison	3.7	4.83	5.6	5.33	3.1	2.72	4.0	3.30
Computation	2.1	1.51	2.3	1.84	1.8	1.51	2.6	1.99
Vocabulary	7.3	4.29	10.9	5.24	6.1	3.55	11.2	5.17
Tool Matching	2.0	2.08	1.8	2.20	1.4	2.02	1.4	2.31

indicating that the wrong score might be an important piece of psychometric information.

Tables 5 and 6 summarize the results of the two-way analyses of variance conducted on the data for the MR group. It can be seen that, except for the practice factor on the Name Comparison subtest, using wrong score as the dependent variable, no significant results were obtained. It is safe to conclude that, with respect to present GATB test materials, the use of extra practice problems or the elimination of separate answer sheets has no appreciable effect on the test performance of mentally retarded persons.

In contrast, extra practice and the elimination of separate answer sheets made a significant difference for the three other groups (CLA, GC, and HS). (For reasons of conciseness and economy, the ANOVA tables for these groups are not included in this report.) The same finding is reflected in Tables 7 and 8, which summarize the results of the three-way analyses of variance. For the right score analysis (Table 7), ability level (alone and in interaction with the other factors) stands out as the single most significant factor in the analysis. This is not quite the case for the wrong score analysis (Table 8). However, even Table 8 shows the pervasive influence of the ability factor. These results support the conclusion that extra practice and elimination of separate answer sheets may benefit non-mentally retarded groups but are of no demonstrable advantage to the mentally retarded.

Table 9 shows the intercorrelation of the GATB tests for the right and wrong scores, for the four ability groups. It should be noted how similar these intercorrelations are, in magnitude, direction and pattern for the different groups including the MR group. Thus, one might infer that the patterning of abilities (or alternatively, the ability domain structure) for MR's is similar

Table 5

Two-way analyses of variance;

Right scores as the dependent variable, for the mentally retarded group

Name Comparison

Source of variation	SS	DF	MS	F
Practice (P)	90.26	1	90.26	0.55
Answer Sheet (AS)	101.81	1	101.81	0.62
P x AS	305.18	1	305.18	1.86
Error	10505.15	64	164.14	
Total	11002.40	67		

Computation

Source of variation	SS	DF	MS	F
Practice (P)	0.96	1	0.96	0.03
Answer Sheet (AS)	18.14	1	18.14	0.51
P x AS	51.08	1	51.08	1.44
Error	2263.09	64	35.36	
Total	2333.27	67		

Vocabulary

Source of variation	SS	DF	MS	F
Practice (P)	0.18	1	0.18	0.01
Answer Sheet (AS)	32.85	1	32.85	1.92
P x AS	25.52	1	25.52	1.49
Error	1097.36	64	17.15	
Total	1155.91	67		

Tool Matching

Source of Variation	SS	DF	MS	F
Practice (P)	143.12	1	143.12	2.23
Answer Sheet (AS)	87.09	1	87.09	1.36
P x AS	0.14	1	0.14	0.00
Error	4107.51	64	64.18	
Total	4337.86	67		

Table 6

Two-way analyses of variance:

Wrong scores as the dependent variable, for the mentally retarded group

Name Comparison

Source of variation	SS	DF	MS	F
Practice (P)	435.89	1	435.89	6.55*
Answer Sheet (AS)	195.76	1	195.76	2.94
P x AS	66.75	1	66.75	1.00
Error	4260.25	64	66.57	
Total	4958.65	67		

Computation

Source of variation	SS	DF	MS	F
Practice (P)	15.40	1	15.40	1.54
Answer Sheet (AS)	0.73	1	0.73	0.07
P x AS	22.05	1	22.05	2.20
Error	640.16	64	10.00	
Total	678.34	67		

Vocabulary

Source of variation	SS	DF	MS	F
Practice (P)	67.65	1	67.65	0.80
Answer Sheet (AS)	69.44	1	69.44	0.82
P x AS	14.88	1	14.88	0.18
Error	5402.79	64	84.42	
Total	5554.76	67		

Tool Matching

Source of variation	SS	DF	MS	F
Practice (P)	75.51	1	75.51	3.99
Answer Sheet (AS)	4.27	1	4.27	0.23
P x AS	0.52	1	0.52	0.03
Error	1209.69	64	18.90	
Total	1289.99	67		

* Probability of rejecting null hypothesis $\leq .05$

Table 7
Three-way analysis of variance:
Right scores as the dependent variable

Name Comparison

Source of variation	SS	DF	MS	F
Practice (P)	1421.49	1	1421.49	7.53**
Answer Sheet (AS)	12369.51	1	12369.51	65.50**
Ability Level (AL)	138707.21	3	46235.74	244.84**
P x AS	2.18	1	2.18	.01
P x AL	1488.38	3	496.13	2.63*
AS x AL	7202.51	3	2400.84	12.71**
P x AS x AL	767.46	3	255.82	1.35
Error	122745.19	650	188.84	
Total	284703.93	665		

Computation

Source of variation	SS	DF	MS	F
Practice (P)	112.99	1	112.99	4.44*
Answer Sheet (AS)	156.33	1	156.33	6.14*
Ability Level (AL)	20187.19	3	6729.07	264.34**
P x AS	7.82	1	7.82	.31
P x AL	140.24	3	46.75	1.84
AS x AL	948.83	3	316.28	12.42**
P x AS x AL	213.67	3	71.22	2.80*
Error	16546.62	650	25.46	
Total	38313.69	665		

Vocabulary

Source of variation	SS	DF	MS	F
Practice (P)	97.17	1	97.17	2.16
Answer Sheet (AS)	38.15	1	38.15	.85
Ability Level (AL)	46029.75	3	15343.25	341.20**
P x AS	41.88	1	41.88	.93
P x AL	114.35	3	38.12	.85
AS x AL	2161.83	3	720.61	16.02**
P x AS x AL	442.65	3	147.55	3.28*
Error	29229.49	650	44.97	
Total	78155.27	665		

Tool Matching

Source of variation	SS	DF	MS	F
Practice (P)	273.35	1	273.35	6.80**
Answer Sheet (AS)	1206.51	1	1206.51	30.03**
Ability Level (AL)	12145.10	3	4048.37	100.76**
P x AS	13.06	1	13.06	.33
P x AL	546.52	3	182.17	4.53**
AS x AL	93.08	3	31.03	.77
P x AS x AL	50.18	3	16.73	.42
Error	26116.63	650	40.18	
Total	40444.43	665		

* Probability of rejecting null hypothesis $\leq .05$
** Probability of rejecting null hypothesis $\leq .01$

Table 8
Three-way analysis of variance:
Wrong scores as the dependent variable

Name Comparison

Source of variation	SS	DF	MS	F
Practice (P)	279.06	1	279.06	13.24**
Answer Sheet (AS)	244.01	1	244.01	11.57**
Ability Level (AL)	470.20	3	156.73	7.43**
P x AS	23.74	1	23.74	1.13
P x AL	307.71	3	102.57	4.86**
AS x AL	101.37	3	33.79	1.60
P x AS x AL	67.76	3	22.59	1.07
Error	13703.99	650	21.08	
Total	15197.84	665		

Computation

Source of variation	SS	DF	MS	F
Practice (P)	6.40	1	6.40	1.20
Answer Sheet (AS)	20.44	1	20.44	3.85*
Ability Level (AL)	239.95	3	79.98	15.06**
P x AS	0.26	1	0.26	0.05
P x AL	25.03	3	8.34	1.57
AS x AL	30.84	3	10.28	1.94
P x AS x AL	64.26	3	21.42	4.03**
Error	3451.32	650	5.31	
Total	3838.20	665		

Vocabulary

Source of variation	SS	DF	MS	F
Practice (P)	0.97	1	0.97	0.03
Answer Sheet (AS)	3171.80	1	3171.80	94.91**
Ability Level (AL)	2342.37	3	780.78	23.36**
P x AS	41.65	1	41.65	1.25
P x AL	184.94	3	61.65	1.84
AS x AL	870.43	3	290.14	8.68**
P x AS x AL	230.29	3	76.76	2.30
Error	21722.24	650	33.42	
Total	28564.69	665		

Tool Matching

Source of variation	SS	DF	MS	F
Practice (P)	51.42	1	51.42	7.07**
Answer Sheet (AS)	18.14	1	18.14	2.49
Ability Level (AL)	64.33	3	21.44	2.95*
P x AS	0.29	1	0.29	0.04
P x AL	64.06	3	21.35	2.94*
AS x AL	8.71	3	2.90	0.40
P x AS x AL	22.22	3	7.41	1.02
Error	4728.38	650	7.27	
Total	4957.55	665		

* Probability of rejecting null hypothesis $\leq .05$
** Probability of rejecting null hypothesis $\leq .01$

Table 9

Correlation Matrices of GATB test right and wrong scores

for each subject group*

Mentally Retarded Persons (N=68)

Variable	1	2	3	4	5	6	7
1. Name Comparison (R)							
2. Computation (R)	.55						
3. Vocabulary (R)	.43	.32					
4. Tool Matching (R)	.52	.43	.30				
5. Name Comparison (W)	.03	.06	-.26	-.07			
6. Computation (W)	-.07	-.48	-.13	-.09	.20		
7. Vocabulary (W)	.32	.24	-.01	.16	.33	.30	
8. Tool Matching (W)	-.18	-.11	-.23	-.40	.54	.19	.20

High School Students (N=137)

Variable	1	2	3	4	5	6	7
1. Name Comparison (R)							
2. Computation (R)	.37						
3. Vocabulary (R)	.37	.45					
4. Tool Matching (R)	.57	.15	.17				
5. Name Comparison (W)	-.07	-.29	-.06	.13			
6. Computation (W)	.03	-.52	-.06	.13	.34		
7. Vocabulary (W)	.26	-.17	-.29	.24	.13	.37	
8. Tool Matching (W)	.06	-.05	.04	-.22	.13	.16	.05

Table 9 (Continued)

Correlation matrices of GATB test right and wrong scores for each subject group*

General College Students (N=77)

Variable	1	2	3	4	5	6	7
1. Name Comparison (R)							
2. Computation (R)	.54						
3. Vocabulary (R)	.36	.29					
4. Tool Matching (R)	.56	.23	.10				
5. Name Comparison (W)	.10	-.20	-.10	-.02			
6. Computation (W)	.01	-.33	-.01	.21	.29		
7. Vocabulary (W)	.57	.25	.04	.38	.11	.13	
8. Tool Matching (W)	.01	-.17	-.07	.06	.42	.44	.06

College of Liberal Arts Students (N=384)

Variable	1	2	3	4	5	6	7
1. Name Comparison (R)							
2. Computation (R)	.50						
3. Vocabulary (R)	.41	.28					
4. Tool Matching (R)	.55	.32	.20				
5. Name Comparison (W)	.05	-.08	-.13	.09			
6. Computation (W)	.09	-.37	-.09	.07	.25		
7. Vocabulary (W)	.30	.23	-.13	.30	.24	.22	
8. Tool Matching (W)	.09	-.06	-.13	.01	.35	.18	.21

* Correlations of right and wrong scores within tests are underlined.

to that of other groups. If this conclusion is verified, it would support the usefulness of a multi-variate approach to the assessment of the vocational abilities of mentally retarded individuals. It would likewise argue against continued reliance on IQ (or other forms of "total" score) in the vocational assessment of these individuals.

Finally, it is worth noting again that wrong scores yield new information as shown by the low intercorrelations with right scores in Table 9. This is true for the MR group as for the other groups. If reliable, the wrong score might prove to be a useful measure of "ability".

GATB Study 2

Group vs individual and speeded vs non-speeded administration, and ability test performance

Purpose

This study was planned to examine the performance of mentally retarded persons under conditions of group versus individual test administration, and speeded versus non-speeded test administration. It was hypothesized that individual administration of test instructions with individual review of test problems would improve the performance of mentally retarded persons. It was further hypothesized that administration of tests under non-speeded (no time limit) conditions, as opposed to speeded (with time limit) conditions, would improve the performance of mentally retarded persons.

Method

Subjects--Three different groups of subjects, representing three levels of ability, were involved in the present study: 1) a group of 59 mentally retarded (MR) persons from two sheltered workshops in Minnesota; 2) a group of 121 high school (HS) students from two Minneapolis high schools; and 3) a group of 106 College of Liberal Arts (CLA) students at the University of Minnesota.

Instruments--Two GATB B-1002B tests were used: Computation and Vocabulary. Items from these tests were administered in their standard order. Subjects in all experimental conditions were required to answer items on separate IBM answer sheets. The standard number of practice problems was used in all experimental conditions. Test administrators followed standard procedures except in the non-speeded conditions, where appropriate changes were made.

Experimental design--Subjects from each of the three groups were assigned at random to one of four experimental conditions: (a) individual administration with a six-minute time limit; (b) individual administration with no time limit; (c) group administration with a six-minute time limit; and (d) group administration with no time limit. Once assigned to a given condition, a subject received both GATB subtests under the same condition.

Analysis--Since different experimental conditions employed different time limits, the total number of correct or incorrect answers (right or wrong scores) would be inappropriate measures of performance. That is, direct comparisons between speeded and non-speeded test administration could not be made using these scores. Instead, the percentage of items answered correctly out of those attempted was taken as the dependent variable for the present study. A further problem arose with regard to this

particular dependent variable. Since GATB items are presented in an ascending order of idfficulty, having time to answer more difficult items toward the end of the tests would tend to lower one's percentage of items answered correctly. Consequently, in addition to scoring for all items attempted (total item scoring), a second dependent variable was constructed by scoring only the first twenty items of each test (reduced item scoring).

The two independent variables, mode of administration (individual versus group) and time limit (six minute time limit versus no time limit) constituted fixed, completely crossed factors for analysis. Two-way analyses of variance were run for each subject group. In addition three-way analyses of variance were run using ability level (subject group) as a classification (blocking) variable, principally to observe any interactions among the independent variables. (These latter analyses were not entirely legitimate since it was impossible to assign subjects at random to ability levels.)

Results

Table 10 shows the means and standard deviations for total item scoring (percentage correct of all items attempted), for the three groups of subjects. The table shows a progression in mean scores, for both GATB subtests, with the MR group being the most variable and the CLA group the least variable. In almost every instance, mean scores were higher under the speeded condition than under the non-speeded condition.

Table 11 shows the means and standard deviations for reduced item scoring (percentage correct of the first 20 items attempted). The same observations about progression in means and standard deviations can be made for reduced item scoring as were made for total item scoring. However, it is only for the

Table 10

Means and standard deviations for percentage correct of all items attempted (total item scoring), by experimental condition

	Individual				Group			
	Speeded		Non - Speeded		Speeded		Non - Speeded	
Test	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
MR Group	(N=15)		(N=14)		(N=15)		(N=15)	
Computation	71.4	22.44	54.5	29.04	68.9	35.62	59.3	28.47
Vocabulary	53.1	23.72	32.1	23.68	54.6	31.05	30.5	12.90
HS Group	(N=18)		(N=17)		(N=43)		(N=43)	
Computation	85.5	11.92	80.3	14.47	84.0	14.31	84.2	10.66
Vocabulary	64.4	14.07	41.1	14.62	58.5	17.75	43.2	8.62
CLA Group	(N=25)		(N=23)		(N=32)		(N=26)	
Computation	94.4	6.00	92.7	8.00	96.4	4.46	94.3	5.50
Vocabulary	80.8	11.04	70.2	12.34	80.4	11.07	67.0	9.69

Table 11

Means and standard deviations for percentage correct of the first 20 items attempted (reduced item scoring), by experimental condition

	Individual				Group			
	Speeded		Non - Speeded		Speeded		Non - Speeded	
Test	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
MP Group	(N=15)		(N=14)		(N=15)		(N=15)	
Computation	73.9	22.21	59.6	29.32	69.1	35.58	62.2	32.72
Vocabulary	55.0	24.96	47.6	28.85	57.4	31.11	42.4	22.51
HS Group	(N=18)		(N=17)		(N=43)		(N=43)	
Computation	88.0	9.69	84.7	14.34	85.6	14.48	90.2	9.69
Vocabulary	70.7	13.16	65.9	21.40	65.5	18.64	67.6	14.20
CLA Group	(N=25)		(N=23)		(N=32)		(N=26)	
Computation	96.0	5.14	96.1	6.90	98.0	4.90	98.3	2.43
Vocabulary	91.8	7.88	93.3	8.61	90.5	9.05	91.7	7.84

MR groups that we find the mean scores higher under the speeded condition than under the non-speeded condition. The reverse (higher under the non-speeded condition) was true for the CLA group and for the HS subjects under group administration conditions.

Tables 12 and 13 summarize the results of the two-way analyses of variance for the MR group. Only one significant finding was observed: a significant effect for the time limit factor on the Vocabulary test, with total item scoring as the dependent variable. Referring back to Table 10, one finds that, contrary to expectations, Vocabulary scores for the MR group are higher under the speeded condition. Hence, one must conclude that there is little to be gained by individual test administration and removal of time limits on the performance of mentally retarded individuals on the GATB Computation and Vocabulary tests.

Tables 14 and 15 summarize the three-way analyses of variance. These results show, unsurprisingly, that ability level is the most important factor of the three (ability level, time limit, and mode of administration) in performance on the GATB Computation and Vocabulary tests for both total item scoring and reduced item scoring. Use of time limits was a significant factor when total item scoring was the dependent variable. The looked-for interactions among the three independent variables failed to materialize.

Table 12

Two-way analyses of variance for total item scoring, for the mentally retarded group

Computation

Source of variance	SS	DF	MS	F
Mode of Administration	19.49	1	19.49	0.02
Time Limit	2600.27	1	2600.27	3.03
Mode x Time	192.76	1	192.76	.22
Error	47132.97	55	856.93	
Total	49945.49	58		

Vocabulary

Source of variance	SS	DF	MS	F
Mode of Administration	.09	1	.09	0.00
Time Limit	7503.22	1	7503.22	13.32**
Mode x Time	36.28	1	36.28	0.06
Error	30991.20	55	563.48	
Total	38530.79	58		

** Probability of rejecting null hypothesis $\leq$ .01

Table 13

Two-way analyses of variance for reduced item scoring, for the mentally retarded group

Computation

Source of variance	SS	DF	MS	F
Mode of Administration	18.53	1	18.53	0.02
Time Limit	1659.55	1	1659.55	1.80
Mode x Time	199.42	1	199.42	0.22
Error	50794.28	55	923.53	
Total	52671.78	58		

Vocabulary

Source of variance	SS	DF	MS	F
Mode of Administration	29.78	1	29.78	0.04
Time Limit	1841.52	1	1841.52	2.52
Mode x Time	215.21	1	215.21	0.29
Error	40180.41	55	730.55	
Total	42266.92	58		

Table 14

Three-way analyses of variance for total item scoring

Computation

Source of variance	SS	DF	MS	F
Mode of Administration	118.96	1	118.96	0.47
Time Limit	2137.68	1	2137.68	8.38**
Ability Level	36001.34	2	18000.34	70.54**
Mode x Time	259.61	1	259.61	1.02
Mode x Ability	6.26	2	3.13	0.01
Time x Ability	1409.82	2	704.91	2.76
Mode x Time x Ability	169.35	2	84.67	0.33
Error	69916.37	275	255.17	
Total	110019.39	285		

Vocabulary

Source of variance	SS	DF	MS	F
Mode of Administration	51.04	1	51.04	0.21
Time Limit	19103.45	1	19103.45	78.66**
Ability Level	47196.24	2	23598.12	97.17**
Mode x Time	.08	1	.08	0.00
Mode x Ability	30.43	2	15.21	0.06
Time x Ability	1147.86	2	573.93	2.36
Mode x Time x Ability	304.07	2	152.03	0.63
Error	66542.90	274	242.86	
Total	134376.07	285		

** Probability of rejecting null hypothesis $\leq .01$

Table 15

Three-way analyses of variance for reduced item scoring

Computation

Source of variance	SS	DF	MS	F
Mode of Administration	43.26	1	43.26	0.17
Time Limit	643.86	1	643.86	2.48
Ability Level	35933.61	2	17866.81	69.11**
Mode x Time	410.28	1	410.28	1.58
Mode x Ability	103.19	2	51.60	0.20
Time x Ability	1400.76	2	700.38	2.69
Mode x Time x Ability	226.14	2	113.07	0.43
Error	71234.96	274	259.98	
Total	109996.06	285		

Vocabulary

Source of variance	SS	DF	MS	F
Mode of Administration	146.74	1	146.74	0.50
Time Limit	866.19	1	866.19	2.96
Ability Level	69601.55	2	34800.78	118.93**
Mode x Time	1.99	1	1.99	0.01
Mode x Ability	1.28	2	0.64	0.00
Time x Ability	1516.28	2	758.14	2.59
Mode x Time x Ability	496.09	2	248.04	0.85
Error	80177.21	274	292.62	
Total	152807.33	285		

** Probability of rejecting null hypothesis $\leq .01$

GATB Study 3

Influence of verbal loading on ability test performance

Purpose

The purpose of this study was to investigate the effect of the verbal ability factor on the ability test performance of the mentally retarded. On the assumption that the mentally retarded person's test performance is weakest on items requiring verbal ability, it was hypothesized that by removing items which correlated with verbal ability from measures of other ability dimensions, one could increase the validity of the latter measures for use with the mentally retarded.

Method

Subjects--The subjects of this study were 667 Minnesota Division of Vocational Rehabilitation (DVR) clients, a sample of 53 mentally retarded DVR clients, and a second group of 60 non-retarded DVR clients.

Instruments--Six tests of GATB Form B-1002B were used: Name Comparison, Computation, Three-Dimensional Space, Tool Matching, Arithmetic Reasoning, and Form Matching. The performance tests were not included since these were not constructed from separate items. The Vocabulary test was used as the measure of Verbal Ability. All tests were administered in the standard manner.

Analysis--Since the verbal ability loading of test items can be estimated from their correlation with a verbal (e.g., vocabulary) measure, the first objective of the analysis was to eliminate from the six GATB tests those items that correlated with the Vocabulary test. The GATB performance of 667 DVR clients was examined for this purpose, and the correlation of scores on each of the items on the six GATB tests with total score on the Vocabulary test was computed. All items which correlated significantly (for N's > 20

persons) were classified according to three levels of correlation: 1) $\geq$ .25; 2) $\geq$ .20; and 3) $\geq$ .15. These items constituted the "verbally loaded" items (the higher the correlational level, the more verbally loaded). After progressively eliminating "verbally loaded" items, GATB test scores were recomputed for a sample of 53 retarded DVR clients and a sample of 60 non-retarded DVR clients (separate scores for each of the three levels of verbal loading). The degree of overlap between these two groups (retarded vs. non-retarded), using the Tilton overlap statistic, was computed at each level of verbal loading.

Results

Table 16 shows the percent of overlap between the retarded and non-retarded groups for the different levels of verbal loading. It can be seen that the overlap between the groups increased after elimination of items for the Three-Dimensional Space and Arithmetic Reasoning tests. However, for the remaining four GATB tests the overlap between the groups did not increase as the items which correlated significantly with the Vocabulary test were progressively eliminated. Table 17 details the number of items removed at each level of elimination.

These data suggest that the elimination of items correlating with verbal ability in the Three-Dimensional Space and Arithmetic Reasoning tests of the GATB can lead to more accurate measurement of these two vocational abilities for the mentally retarded. For the four other GATB tests studied (Name Comparison, Computation, Tool Matching and Form Matching), the elimination of such items failed to produce the desired effect.

Table 16
Tilton's Overlap between retarded (N=53) and non-retarded (N=60) DVR groups

GATB Test	Overlap with no items removed	Overlap with items correlating ≥.25 removed	Overlap with items correlating ≥.20 removed	Overlap with items correlating ≥.15 removed
1. Name Comparison	63.1	64.5	67.0	68.7
2. Computation	51.0	52.0	53.0	54.0
3. Three-Dimensional Space	60.0	63.0	71.5	75.0
4. Tool Matching	80.5	78.5	80.0	81.0
5. Arithmetic Reasoning	42.0	41.5	40.5	70.0
6. Form Matching	69.0	68.0	68.0	66.0

[a]Interpreted as the percentage of scores in one distribution that can be contained in the other distribution.

Table 17

Number of items eliminated, by level

GATB Test	$r \geq .25$	$r \geq .20$	$r \geq .15$	Total
1. Name Comparison	4	8	7	19
2. Computation	1	3	9	13
3. Three-Dimensional Space	8	13	6	27
4. Tool Matching	4	3	9	16
5. Arithmetic Reasoning	4	4	9	17
6. Form Matching	1	1	6	8

GATB Study 4

Difficulty of instruction and practice, and ability test performance

Purpose

This study was designed to investigate the effects of the difficulty of test instructions and the difficulty of practice problems on ability test performance. It was hypothesized that by simplifying instructions and practice problems, mentally retarded individuals would perform better in ability tests.

Method

Subjects--The subjects of the study were 167 mentally retarded individuals from seven Minnesota sheltered workshops. (See Introduction for a more detailed description of this group.)

Instruments--Four GATB B-1002B tests were used in the present study: Name Comparison, Computation, Vocabulary, and Tool Matching. The tests were administered under standard time limits and with the items in their usual order. Separate answer sheets were not used in any of the experimental conditions. Examinees were required to answer the items on the test booklets themselves.

Twice as many practice problems as found in the standard GATB tests were used in all of the experimental conditions. There were 12 practice problems for Name Comparison, 4 for Computation, 6 for Vocabulary and 4 for Tool Matching. For each test, two instructional problems (from the standard GATB) were used in demonstrating the test task prior to practice on the practice problems.

Experimental design--The study took the form of a 2 x 2 factorial experiment. Each subject was assigned at random to one of four experimental conditions. (a) Standard difficulty instructions and standard difficulty practice; (b) Standard difficulty instructions and simplified practice; (c) Simplified instructions and standard difficulty practice; (d) Simplified instructions and simplified practice. Once assigned to a given experimental condition, a subject received all four tests under that experimental condition.

"Standard difficulty instructions" were standard GATB instructions modified for a no-separate-answer-sheet administration. "Simplified instructions" involved the elimination of all written directions, the simplification of oral directions, and the use of group demonstration cards for the practice items. For "standard difficulty practice" condition, GATB instructional and practice problems were kept in their original order, and practice problems of similar difficulty were added to the standard practice problems. "Simplified practice" involved the addition of simplified and less difficult problems and the rearrangement of instructional and practice problems so that easier problems came first.

Analysis--Two dependent variables were used: right scores and wrong scores. An individual's right score for a given subtest was the total number of items he answered correctly. An individual's wrong score for a given test was the total number of items he answered incorrectly.

The two independent variables, difficulty of instructions and difficulty of practice, constituted fixed, completely crossed factors for analysis. Two-way analyses of variance were run for both right and wrong scores.

Results

Right score means and standard deviations for each experimental condition are shown in Table 18. Wrong score means and standard deviations are given in Table 19. Results of the two-way analyses of variance for right and wrong scores are summarized in Tables 20 and 21 respectively. As these tables show, the only significant finding was the difference in wrong-score means for the Computation test found between those taking the test under simplified instructions and those taking the test under standard instructions. The direction of the difference was opposite to that expected, with poorer performance on the part of subjects under the simplified instructions condition (they obtained higher wrong scores). It can only be concluded, therefore, that simplifying instructions and practice problems was not shown to be helpful in improving the ability test performance of mentally retarded individuals.

Table 22 shows the intercorrelations among right and wrong scores for the four GATB tests.(See GATB Study 1 for similar data.) Subjects in all four treatments combined were used in calculating these correlations. Intercorrelations between right scores were generally high, ranging from .55 to .76. Wrong score intercorrelations were lower, ranging from .20 to .50. Correlations between right and wrong scores within tests ranged from -.16 to .27, demonstrating the relative independence of the two dependent variables included in the study. It can be concluded that added information about the abilities of mentally retarded persons could be gained through the use of "wrong" scores (scoring wrong responses).

Table 18

Right score means and standard deviations
by treatment combination

GATB Test	Standard difficulty instructions				Simplified instructions			
	Standard difficulty practice		Simplified practice		Standard difficulty practice		Simplified practice	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Name Comparison	28.3	17.01	28.6	15.33	25.4	14.85	26.4	14.57
Computation	9.5	7.83	9.8	7.30	8.2	6.22	10.4	6.85
Vocabulary	7.3	5.69	8.0	6.86	6.2	6.34	7.1	6.48
Tool Matching	19.6	9.05	18.2	8.39	16.9	9.43	9.0	9.91

Table 19

Wrong score means and standard deviations
by treatment combination

GATB Test	Standard difficulty instructions				Simplified instructions			
	Standard difficulty practice		Simplified practice		Standard difficulty practice		Simplified practice	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
	(N=47)		(N=37)		(N=44)		(N=39)	
Name Comparison	5.9	4.96	6.6	6.52	7.0	5.32	6.4	5.95
Computation	2.6	2.20	3.8	4.11	6.2	5.65	5.8	7.27
Vocabulary	9.7	8.42	8.9	10.44	7.7	7.15	10.0	9.58
Tool Matching	3.4	4.20	3.2	4.19	5.2	6.87	3.7	3.72

Table 20

Two-way analyses of variance:
Right scores as the dependent variable

Name Comparison

Source of variation	SS	DF	MS	F
Instructions	271.78	1	271.78	1.13
Practice	17.46	1	17.46	.07
Instr x Pract	4.39	1	4.39	.02
Error	39336.40	163	241.33	
Total	39630.03	166		

Computation

Source of variation	SS	DF	MS	F
Instructions	4.14	1	4.14	.08
Practice	58.63	1	58.63	1.17
Instr x Pract	36.89	1	36.89	.73
Error	8192.04	163	50.26	
Total	8291.70	166		

Vocabulary

Source of variation	SS	DF	MS	F
Instructions	44.16	1	44.16	1.11
Practice	27.29	1	27.29	.68
Instr x Pract	.28	1	.28	.01
Error	6512.12	163	39.95	
Total	6583.85	166		

Tool Matching

Source of variation	SS	DF	MS	F
Instructions	40.25	1	40.25	.47
Practice	4.88	1	4.88	.06
Instr x Pract	125.91	1	125.91	1.48
Error	13862.78	163	85.05	
Total	14033.82	166		

Table 21

Two-way analyses of variance:
Wrong scores as the dependent variable

Name Comparison

Source of variation	SS	DF	MS	F
Instructions	8.29	1	8.29	0.26
Practice	0.20	1	0.20	0.01
Instr x Pract	17.96	1	17.96	0.56
Error	5224.61	163	32.05	
Total	5251.06	166		

Computation

Source of variation	SS	DF	MS	F
Instructions	327.21	1	327.21	12.66**
Practice	6.34	1	6.34	0.25
Instr x Pract	24.88	1	24.88	0.96
Error	4212.28	163	25.84	
Total	4570.71	166		

Vocabulary

Source of variation	SS	DF	MS	F
Instructions	9.01	1	9.01	0.11
Practice	22.86	1	22.86	0.29
Instr x Pract	102.62	1	102.62	1.30
Error	12870.52	163	78.96	
Total	13005.01	166		

Tool Matching

Source of variation	SS	DF	MS	F
Instructions	53.87	1	53.87	2.20
Practice	31.94	1	31.94	1.30
Instr x Pract	16.76	1	16.76	0.68
Error	3999.56	163	24.54	
Total	4102.13	166		

** Probability of rejecting null hypothesis $\leq .01$

Table 22

Correlation matrix of GATB test right and wrong scores[a] (N=167)

	1	2	3	4	5	6	7
1. Name Comparison (R)							
2. Computation (R)	.76						
3. Vocabulary (R)	.71	.69					
4. Tool Matching (R)	.72	.62	.55				
5. Name Comparison (W)	-.01	-.16	-.24	-.01			
6. Computation (W)	-.09	-.16	-.15	.03	.46		
7. Vocabulary (W)	.41	.31	.27	.39	.20	.27	
8. Tool Matching (W)	-.13	-.19	-.21	-.10	.35	.50	.21

[a]Correlations of right and wrong scores within subtests are underlined.

MIQ Study 1

Item development

Purpose

The purpose of this study was to begin construction of a pair comparisons form of the Minnesota Importance Questionnaire (MIQ) for use with mentally retarded individuals. Specifically, the study was directed toward developing an item pool from the original MIQ items which would: 1) be understandable to adult mentally retarded individuals; and 2) yield results equivalent to those of the standard form of the MIQ when applied to a non-retarded group.

Method

Subjects--Thirty-six mentally retarded individuals employed in a sheltered workshop constituted one sample of subjects in this study. A second subject sample (for comparison purposes) consisted of 29 clients of the State Division of Vocational Rehabilitation who were considered "normal" (i.e., non-retarded) and who were sent to the Work Adjustment Project for vocational assessment.

Procedure--The standard form of the MIQ consists of the 20 statements in a pair comparison format. Each statement represents one need dimension. Table 23 lists the 20 vocational need dimensions measured by the MIQ, each dimension's representative statement on the regular MIQ form, and a corresponding, simplified statement revised for use with the mentally retarded. These revised statements were judged by a graduate seminar in psychology to be equivalent in meaning to the regular MIQ statements, but to require lower verbal ability to understand them.

Table 23

MIQ scales: Regular and revised statements

	Scale Name		Regular (Reg) and Revised (Rev) Statements
1.	Ability Utilization.....	Reg:	I could do something that makes use of my abilities.
		Rev:	You could do the things that you know how to do best.
2.	Achievement.....	Reg:	The job could give me a feeling of accomplishment.
		Rev:	The job could give you a feeling that you were really getting something done.
3.	Activity.....	Reg:	I could be busy all the time.
		Rev:	You could be busy all the time.
4.	Advancement.....	Reg:	The job would provide an opportunity for advancement.
		Rev:	You could move up to a better job.
5.	Authority.....	Reg:	I could tell people what to do.
		Rev.	You could tell people what to do.
6.	Company Policies and Practices.....	Reg:	The company would administer its policies fairly.
		Rev:	The company would treat everybody the same.
7.	Compensation.....	Reg:	My pay would compare well with that of other workers.
		Rev:	You could make as much money as anybody else on that job.
8.	Co-Workers.....	Reg:	My co-workers would be easy to make friends with.
		Rev:	You could be friends with the people you work next to.
9.	Creativity.....	Reg:	I could try out some of my own ideas.
		Rev:	You could try your own way of doing the job.
10.	Independence.....	Reg:	I could work alone on the job.
		Rev:	You could work alone on the job.

Table 23 (continued)

MIQ scales: Regular and revised statements

Scale Name	Regular (Reg) and Revised (Rev) Statements
11. Moral Values.....	Reg: I could do the work without feeling tht it is morally wrong. Rev: You could do the work without other people thinking you were a bad person.
12. Recognition.....	Reg: I could get recognition for the work I do. Rev: Someone would tell you you're doing a good job.
13. Responsibility.....	Reg: I could make decisions on my own. Rev: You could make up your own mind about how to do things on the job.
14. Security.....	Reg: The job would provide for steady employment. Rev: It would be steady work.
15. Social Service.....	Reg: I could do things for other people. Rev: You could do things for other people.
16. Social Status.....	Reg: I could be "somebody" in the community. Rev: The neighbors would think you had a good job.
17. Supeervision-Human Relations.....	Reg: My boss would back up his men (with top management). Rev: Your boss would help you out when you're in trouble.
18. Supervision-Technical...	Reg: My boss would train his men well. Rev: Your boss would show you how to do the job well.
19. Variety.....	Reg: I could do something different every day. Rev: You could do something different on your job every day.
20. Working Conditions.....	Reg: The job would have good working conditions. Rev: The place where you work will be nice.

The mentally retarded (MR) sample was divided into 3 groups of 12 persons each. Each group was administered a different subset of the revised statements. This reduced the number of pair comparisons to be administered, the most being 21 pairs (for 7 statements). The first group was given Form I, which consisted of the following 7 dimensions: Company Policies and Practices, Ability Utilization, Responsibility, Co-workers, Social Service, Supervisor-Human Relations, and Activity. Form II was given to the second group. It consisted of the following 6 dimensions: Supervision-Technical, Security, Achievement, Moral Values, Creativity, and Authority. Form III was administered to the third group. This form consisted of the following 7 dimensions: Recognition, Working Conditions, Variety, Advancement, Independence, Social Status, and Compensation. All administrations were done verbally.

The "normal" sample (the DVR clients) was similarly divided into three groups and the three forms mentioned above administered to them, a different form to each group. In addition, the "normal" subjects had previously completed the regular MIQ form as part of their vocational assessment.

Results

Tables 24 through 26 present statistics summarizing the scores for both mentally retarded (MR) and "normal" (N) samples. The tables also present data on circular triads, logically inconsistent responses in which A is preferred to B, B to C, and C to A. Significant differences in mean circular triad score were obtained between MR and N groups for all three administrations. It is apparent from these data that the MR subjects were more logically inconsistent than the "normal" subjects. The probability of random responding was determined from the data on circular triads. Based on this determination, eight of the MR subjects, compared with three of the "normal" subjects, were judged as having responded randomly. Twenty-two MR and the remaining 26

Table 24

Means and variances for Form I scales, by group (IR vs N)

	Mean			Variance		
	IR(N=12)	N(N=9)	t	IR(N=12)	N(N=9)	F
1. Ability Utilization	2.17	4.00	3.73**	1.42	1.46	1.03
2. Activity	3.08	2.00	2.30*	0.99	1.64	1.66
3. Company Policies and Practices	2.92	3.17	0.35	2.45	3.80	1.55
4. Co-Workers	3.58	2.50	2.98**	0.99	2.27	2.29
5. Responsibility	2.42	3.42	1.82	2.27	1.37	1.66
6. Social Service	3.58	2.58	1.35	2.08	4.27	2.05
7. Supervision - Human Relations	3.25	3.50	0.44	1.84	2.10	1.14
Circular triad score	7.75	4.56	2.07*	11.67	13.03	1.12

* Probability of rejecting null hypothesis $\leq .05$

** Probability of rejecting null hypothesis $\leq .01$

Table 25

Means and variances for Form II scales, by group (MR vs N)

Scales	Mean			Variance		
	MR(N=12)	N(N=9)	t	MR(N=12)	N(N=9)	F
1. Achievement	3.67	4.00	2.41*	1.15	1.00	1.15
2. Authority	1.92	1.36	2.21*	4.08	3.25	1.26
3. Creativity	1.75	2.46	3.97**	2.02	1.66	1.22
4. Moral Values	1.42	1.54	.76	.99	1.88	1.90
5. Security	3.42	1.83	1.57	.99	11.30	11.41**
6. Supervision-Technical	2.83	1.33	7.98**	1.06	3.10	2.92
Circular triad score	1.83	.55	5.82**	4.70	.67	7.01*

* Probability of rejecting null hypothesis $\leq .05$

**Probability of rejecting null hypothesis $\leq .01$

Table 26

Means and variances for Form III scales, by group (MR vs N)

Scales	Mean			Variance		
	MR(N=12)	N(N=9)	t	MR(N=12)	N(N=9)	F
1. Advancement	3.33	4.90	8.53**	2.22	.99	2.24
2. Compensation	2.83	3.00	.67	2.13	4.45	2.09
3. Independence	2.50	2.40	.43	3.53	1.62	2.18
4. Recognition	3.75	4.20	2.01	2.19	2.86	1.31
5. Social Status	2.92	.20	21.08**	1.35	.18	7.50**
6. Variety	3.08	2.60	1.67	7.40	.94	7.87**
7. Working Conditions	2.58	3.70	5.66**	1.54	2.46	1.60
Circular triad score	6.17	1.11	4.64**	8.15	3.10	2.63

* Probability of rejecting null hypothesis $\leq .05$

** Probability of rejecting null hypothesis $\leq .01$

"normal" subjects did not respond randomly. The data were inconclusive for 6 MR subjects. Thus, there is evidence that MR subjects could respond meaningfully to the revised MIQ statements.

Significant differences in mean scores between the MR and "normal" samples were obtained on 10 of the 20 scales. Significant differences in variances were observed for four scales. These findings indicate that MR subjects responded somewhat differently to the revised MIQ items than did the "normal" comparison group subjects, but also that individual differences in response are to be found among MR subjects as among "normals".

Tables 27 through 29 compare the responses of the "normal" subjects to the revised MIQ statements with their responses to the regular MIQ statements. Scores for the regular MIQ statements were reconstructed from their responses to the regular MIQ in such a way as to parallel the three forms using the revised statements. (For example, if a subject completed Form I with the revised statements, his completed regular MIQ was scored for only the Form I scales, i.e., the seven scales listed in Table 27). As Tables do show, similarity between the results for the two forms (revised vs. regular) provide some evidence for the equivalence of the two forms.

This study provided encouragement for the attempt to develop an MIQ form for use with mentally retarded individuals. To be useful, such a form, in addition to meeting the usual psychometric requirements, should exhibit properties of being understandable to MR subjects and at the same time being equivalent to the regular form of the MIQ. The next studies concentrated on the twin problems of understandability and equivalence.

Table 27

Means and standard deviations of Form I MIQ scales for a sample of DVR clients (N=9), by type of statement

Scale	Mean		SD	
	Reg[a]	Rev[b]	Reg	Rev
1. Ability Utilization	4.8	4.0	1.30	1.21
2. Activity	1.9	1.9	1.45	1.28
3. Company Policies and Practices	2.9	3.2	1.61	1.95
4. Co-Workers	2.2	2.0	1.30	1.70
5. Responsibility	2.9	3.4	1.17	1.17
6. Social Service	3.7	2.6	1.94	2.07
7. Supervision-Human Relations	2.7	3.5	2.06	1.45
Circular triad score	3.9	3.6	4.56	4.58

[a] Regular MIQ Statements
[b] Revised MIQ statements

Table 28

Means and standard deviations of form II MIQ scales for a sample of DVR clients (N=9), by type of statement

Scale	Mean		SD	
	Reg[a]	Rev[b]	Reg	Rev
1. Achievement	3.5	4.0	1.44	1.00
2. Authority	1.1	1.4	1.22	1.80
3. Creativity	3.4	2.5	1.29	1.29
4. Moral Values	1.7	1.5	1.42	1.37
5. Security	2.9	1.8	1.45	3.36
6. Supervision-Technical	2.4	1.3	1.03	1.76
Circular triad score	1.7	.5	1.60	.78

[a] [b]Regular MIQ Statements
Revised MIQ Statements

Table 29

Means and standard deviations of Form III MIQ scales for a sample of DVR clients (N=9), by type of statement

Scale	Mean		SD	
	Reg[a]	Rev[b]	Reg	Rev
1. Advancement	5.3	4.9	1.32	.99
2. Compensation	2.7	3.0	1.12	2.11
3. Independence	2.3	2.4	1.73	1.27
4. Recognition	3.3	4.2	1.32	1.69
5. Social Status	1.3	.2	1.32	.42
6. Variety	2.1	2.6	1.45	.97
7. Working Conditions	3.9	3.7	1.62	1.57
Circular triad score	2.4	1.1	2.55	1.76

[a] Regular MIQ Statements
[b] Revised MIQ Statements

MIQ Study 2

Estimation of item understandability

Purpose

This study was designed to estimate the understandability (for mentally retarded individuals) of various versions of the MIQ items. Understandability of the items was to be judged by experienced teachers, counselors, and other persons working with the mentally retarded.

Method

Instrument--An instrument was developed consisting of 55 items representing the 20 scales of the MIQ. Each of the original 20 MIQ items was presented in three different forms. The first item form was the original version of the MIQ item. The second item form was the product of a graduate seminar in psychology (see MIQ Study 1). The third item form was devised by one of the research assistants working on this study. It was not always possible to generate three item forms for comparison. Those scales which had only two item forms were: Activity, Advancement, Authority, Compensation, Independence, Recognition, and Security. Two items were repeated in the instrument to obtain some idea of how carefully the respondents were answering. These two items were presumed to represent extremes of understandability to the mentally retarded.

The instrument called for the respondent to rate the various MIQ item forms in terms of whether it would be understood by the group of mentally retarded persons he/she currently worked with. Each item form was rated on the following scale: N=not understood by any; S=understood by some; M=understood by most; and A=understood by all. For scale values, N was weighted 1, S was weighted

Subjects--The instrument was sent to 19 professional staff members from two organizations in Minneapolis concerned with the retarded. Twelve of these individuals were employed by the Cooperative School Rehabilitation Center (CSRC) and seven were employed by Opportunity Workshop (OWS).

Procedure--Copies of the instrument were sent to the two institutions for completion by their professional staff. CSRC returned 12 instruments and OWS returned 7 of them.

Mean understandability ratings were calculated for each item form. Because of an obvious difference in their ratings, mean ratings were calculated separately for each institution's group of raters.

Results

Table 30 summarizes the ratings, separately for each institution group and for each version (original, seminar, and research assistants). It is clear from this table that both sets of raters rated the original item versions as difficult for the mentally retarded to understand. The version most frequently rated highest in understandability was the seminar version (16 times in 20). OWS raters judged 18 seminar version items as being above 2.5 (midpoint of the scale), while CSRC raters reached the same judgment for 14 seminar version items. The corresponding numbers for the research assistant's version are 9 (by OWS) and 7 (by CSRC).

These data were utilized in constructing a Form M version of the MIQ, consisting of items rated above 2.50 for 18 of the 20 scales by OWS raters and for 15 of the 20 scales by CSRC raters. Median ratings for the Form M items were 3.17, for OWS ratings, and 2.83, for CSRC ratings. Table 31 lists the standard (Form P) and Form M items for each of the 20 MIQ scales.

Table 30

Mean understandability ratings for original and revised MIQ items, by institution

Scale	OWS[a] (N=7) O[c]	OWS[a] (N=7) S[d]	OWS[a] (N=7) RA[e]	CSRC[b] (N=12) O	CSRC[b] (N=12) S	CSRC[b] (N=12) RA
1. Ability Utilization	2.14	3.00	3.00	2.00	2.67	2.83
2. Achievement	1.71	2.57	2.29	1.75	2.33	2.25
3. Activity	(a)	3.59	3.57	(a)	3.17	3.17
4. Advancement	1.71	2.86	(b)	1.75	2.58	(b)
5. Authority	3.43	3.29	(b)	3.08	2.83	(b)
6. Company Policies and Practices	1.29	2.86	3.29	1.08	2.33	2.33
7. Compensation	2.00	3.14	(b)	1.83	2.75	(b)
8. Co-Workers	2.14	3.43	3.57	2.25	3.00	3.33
9. Creativity	2.14	3.00	2.43	2.17	2.33	2.00
10. Independence	3.43	3.71	(b)	3.25	3.17	(b)
11. Moral Values	1.57	2.57	2.00	1.08	2.25	2.17
12. Recognition	2.00	3.57	(b)	1.58	3.08	(b)
13. Responsibility	2.14	2.43	2.17	2.00	2.17	2.00
14. Security	2.14	2.14	(b)	3.17	2.08	(b)
15. Social Service	(a)	3.29	3.00	(a)	3.25	2.92
16. Social Status	2.14	3.29	3.29	1.67	2.92	2.50
17. Supervision-Human Relations	1.86	3.14	3.00	1.33	2.83	2.83
18 Supervision-Technical	2.57	3.17	3.00	2.33	2.92	2.73
19. Variety	3.43	3.14	3.29	2.92	2.67	2.83
20. Working Conditions	2.29	3.57	2.00	2.08	3.58	2.00

[a] OWS= Opportunity Workshop
[b] CSRC= Cooperative School Rehabilitation Center
[c] O= Original version
[d] S= Seminar version
[e] RA= Research assistant version
(a)= omitted; in both cases because the seminar version was identical to the original except for starting the item with "you..." instead of "I..."
(b)= no version written

Table 31

Item stems for Form P (standard) and Form M (revised), by scale

Scale Name	Form P (standard) and Form M (revised) Statements
1. Ability Utlization	Form P: I could do something that makes use of my abilities. Form M: You could do the things that you know how to do best.
2. Achievement	Form P: The job could give me a feeling of accomplishment Form M: The job could give you a feeling that you were really getting something done.
3. Activity	Form P: I could be busy all the time. Form M: You could be busy all the time.
4. Advancement	Form P: The job would provide an opportunity for advancement. Form M: You could move up to a better job.
5. Authority	Form P: (I) could tell people what to do. Form M: (You) could tell people what to do.
6. Company Policies and Practices	Form P: The company would administer its policies fairly. Form M: The people you work for would treat everybody the same.
7. Compensation	Form P: My pay would compare well with that of other workers. Form M: You could make as much money as anybody else on that job.
8. Co-workers	Form P: My co-workers would be easy to make friends with. Form M: You could be friends with the other workers.
9. Creativity	Form P: I could try out some of my ideas. Form M: You could try your own way of doing the job.
10. Independence	Form P: I could work alone on the job. Form M: You could work alone on the job.

Table 31 (continued)

Item stems for Form P (standard) and Form M (revised), by scale

Scale Name	Form P (standard) and Form M (revised) Statements
11. Moral Values	Form P: I could do the work without feeling that it is morally wrong Form M: You could do the work without other people thinking you were a bad person.
112. Recognition	Form P: I could get recognition for the work I do. Form M: Someone would tell you you're doing a good job.
13. Responsibility	Form P: I could make decisions on my own. Form M: You could make up your own mind about how to do things on the job.
14. Security	Form P: The job would provide for steady employment. Form M: The job would provide for steady employment.
15. Social Service	Form P: I could do things for other people. Form M: You could do things for other people.
16. Social Status	Form P: I could be "somebody" in the community. Form M: The neighbors would think you had a good job.
17. Supervision-Human relations	Form P: My boss would back up his men (with top management). Form M: Your boss would help you when you're in trouble.
18. Supervision-Technical	Form P: My boss would train his men well. Form M: Your boss would show you how to do the job well.
19. Variety	Form P: I could do something different every day. Form M: You could do something different on your job every day.
20. Working Conditions	Form P: The job would have good working conditions. Form M: The place where you work will be nice.

MIQ Study 3

Equivalence of Form M and Form P

Purpose

This study was conducted to determine whether or not the revised items of Form M measured the same need dimensions as those measured by the 1967 standard form (designated as Form P). Such equivalence can be evaluated in several ways, e.g., individual item equivalence, profile equivalence, etc. Since the main use of the MIQ in vocational rehabilitation counseling is in terms of profiles, profile equivalence was the focus of the present study.

Method

Subjects--One hundred ten subjects were drawn from the University of Minnesota experimental psychology pool. Most of these subjects were college sophomores majoring in the College of Liberal Arts.

Procedure--Two forms of the MIQ, one standard (Form P) and one revised (Form M) were used in this study. Form M, the revised form, was constructed from item stems resulting from the preceding understandability study. An identical format was employed for both forms, i.e., printing style and size, paper size, instructions and number of items per page.

Subjects were randomly assigned to one of three experimental groups. The design required each subject to complete two forms in an immediate test-retest paradigm. The following were the experimental groups:

Group	Test	Retest	N
Group I	Form P	Form P	42
Group II	Form P	Form M	34
Group III	Form M	Form P	34

To demonstrate equivalence, the test-retest correlations between Forms P and M should not differ significantly from the test-retest correlations between Form P and itself. Furthermore, there should be no ordering effect.

Analysis--Profiles obtained from the test and retest forms of the MIQ were correlated for each individual. The resulting individual (profile) correlations were pooled for each group. The distribution of profile correlations resulting from the Form P test-retest group (Group I) was used as the "control" against which to test the profile-correlation distributions for the other groups.

Results

Table 32 summarizes the data. The median profile correlation for Group the group which repeated the standard form (Form P), was .94. Comparison of the data for Groups II and III showed no significant distribution differences (i.e., there were no order effects.) These data were then combined, yielding a median profile correlation of .85. A median test of the difference between profile correlation distributions for Groups II and III combined and that for Group I was statistically significant.

Since Form M did not show equivalence with Form P at the profile level, equivalence at the scale level was investigated. The relevant data are shown in Table 33. Scale score differences between Form M and Form P were analyzed. This analysis showed that 9 of the 20 scales of Form M yielded results which were significantly different from the corresponding Form P scale results. The eleven scales for which no significant differences were obtained were: Activity, Advancement, Authority, Company Policies, Compensation, Co-Workers, Independence, Security, Social Service, Supervision-Technical, and Variety.

Table 32

Distribution of test-retest (profile) correlations, by group

Correlation range	Group I (P-P)	Groups II & III (P-M & M-P)
.96 - 1.00	7	2
.91 - .95	26	11
186 - .90	5	19
.81 - .85	2	13
.76 - .80	1	11
.71 - .75	1	6
.66 - .70		2
.61 - .65		2
.56 - .60		1
.51 - .55		0
.46 - .50		1
	42	68
Median correlation	.94	.85
Median for combined groups[a]	.89	

[a] χ^2 for median test = 26.5 (1df, P < .001)

Table 33

Cross-correlations for parallel scales from Forms P and M, by scale

Scale	Forms paired	
	P-P(N=42)	P-M(N=68)
1. Ability Utilization	.72	.15***
2. Achievement	.88	.52***
3. Activity	.88	.84
4. Advancement	.81	.73
5. Authority	.87	.91
6. Company Policies	.85	.74
7. Compensation	.90	.86
8. Co-Workers	.89	.80
9. Creativity	.92	.74**
10. Independence	.89	.86
11. Moral Values	.90	.77*
12. Recognition	.90	.39***
13. Responsibility	.86	.68*
14. Security	.80	.89
15. Social Service	.89	.91
16. Social Status	.93	.57***
17. Supervision-Human Relations	.89	.70**
18. Supervision-Technical	.82	.76
19. Variety	.90	.83
20. Working Conditions	.91	.60***

*Probability of $\leq .05$ in rejecting null hypothesis: one tailed testing using Fisher's z transformation.

** Probability of $\leq .01$ in rejecting null hypothesis: one-tailed test.

*** Probability of $\leq .001$ in rejecting null hypothesis: one-tailed test.

MIQ Study 4

Wording revision of nine scales

Purpose

The purpose of this study was to revise the wording of the nine Form M scales found in the preceding study not to be equivalent to Form P scales. These nine scales were: Ability Utilization, Achievement, Creativity, Moral Values, Recognition, Responsibility, Social Status, Supervision-Human Relations and Working Conditions.

Method

Subjects--Ten mentally retarded individuals in a workshop were the subject in this study.

Procedure--Interviews were held individually with the ten mentally retarded subjects. The meanings of words and concepts used in the MIQ were explored in these interviews. Particular attention was given to the mental retardates typical vocabulary. The interviews usually took two hours to complete. Based on information provided by these interviews, the item stems for the nine non-equivalent scales were reworded.

Understandability of the reworded item stems was inferred by applying two formulas that measure vocabulary difficulty, the Dale-Chall and the Flesch formulas. These two formulas were originally developed for measuring the difficulty or reading level of whole paragraphs, but were used here in lieu of formula to assess the reading level of individual sentences.

Results

Listed below are rewordings of the nine stems based on information provided by the interviews:

1. Ability Utilization

   Form P: I could do something that makes use of my abilities.
   Revision: You could do the kind of work that you do best.

2. Achievement

   Form P: The job could give me a feeling of accomplishment.
   Revision: The job could make you feel useful.

3. Creativity

   Form P: I could try out some of my own ideas.
   Revision: You could try to do things the way you think they should be done.

4. Moral Values

   Form P: I could do the work without feeling that it was morally wrong.
   Revision: You would not feel that you were doing wrong.

5. Recognition

   Form P: I could get recognition for the work I do.
   Revision: You could get praise and credit for the work you do.

6. Responsibility

   Form P: I could make decisions on my own.
   Revision: You could decide what you should do without asking someone else.

7. Social Status

   Form P: I could be "somebody" in the community.
   Revision: You could be somebody important in your neighborhood

8. Supervision-Human Relations

   Form P: My boss would back up his men (with top management).
   Revision: Your boss would stick up for his men

9. Working Conditions

   Form P: The job would have good working conditions.
   Revision: The place where you work would be clean, bright and comfortable.

The results of the application of the readability formulas to these nine reworded item stems are shown in Table 34. As Table 34 shows, the attempt at rewriting the item stems at a lower readability level was successful in all but two instances, Creativity and Recognition.

Table 34

Dale-Chall and Flesch readability scores for standard and revised item-stem wordings, by scale

Scale	Dale-Chall[a]		Flesch[b]	
	Form P	Revision	Form P	Revision
1. Ability Utilization	5.7	4.2	78	95
2. Achievement	5.8	4.0	76	85
3. Creativity	4.1	4.3	100	93
4. Moral Values	5.5	4.1	82	86
5. Recognition	5.8	5.6	85	86
6. Responsibility	6.2	4.2	91	59
7. Social Status	8.4	4.0	57	22
8. Supervision-Human Relations	8.8	4.0	95	98
9. Working Conditions	6.2	5.6	80	68

[a] Dale-Chall scores correspond to grade level.

[b] Flesch scores are interpreted as follows:

0-30	College	Very difficult
30-50	High school or some college	Difficult
50-60	Some High school	Fairly difficult
60-70	7th-8th grade	Standard
70-80	6th grade	Fairly easy
80-90	5th grade	Easy
90-100	4th grade	Very easy

MIQ Study 5

Equivalence of Form M, Form MRev and Form P

Purpose

This study was undertaken to investigate the equivalence of three forms of the MIQ: the standard form (Form P) and two forms constructed for use with the mentally retarded (Form M and Form MRev). The latter two forms differ only on the nine scales whose item stems were reworded in the preceding study. Form MRev contains the revised item wording resulting from MIQ Study 4 As in the previous equivalence study, the focus of interest in this study is on profile equivalence.

Method

Subjects--subjects were drawn from the experimental psychology subject pool at the University of Minnesota. These were, for the most part, college sophomores in the College of Liberal Arts.

Procedure--Subjects were randomly assigned to one of the following five experimental groups:

Group	First Administration	Second Administration	N
Group I	Form P	Form M	34
Group II	Form M	Form P	34
Group III	Form P	Form P	42
Group IV	Form P	Form MRev	30
Group V	Form MRev	Form P	30

Each individual was administered the designated forms of the MIQ in an immediate test-retest paradigm. Order of administration of two different forms was controlled by transposing the order of administration of the forms.

Analysis--Because of the availability, at the time of this study, of Occupational Reinforcer Patterns (ORPs) for 81 occupations, it was possible

to use this information in the determination of profile equivalence among forms. Each subject's MIQ profile was compared with each of the 81 ORPs. These 81 ORPs were then ranked in order from most to least correspondence with the subject's MIQ profile. Profile equivalence between any two forms was examined by two methods.

1) For each subject, an agreement percentage between the two forms was computed for the top 20 ranked ORPs and for the bottom 20 ranked ORPs. The average of these two agreement percentages was also calculated.

2) For each subject, the rank order correlation between the ORP rankings resulting from each form was calculated. The product moment correlation between the correspondence scores for each form was also calculated. The same procedures were followed for the ranking of correspondence and correspondence scores, using 9 ORP occupational cluster profiles instead of the 81 ORPs.

Median tests and t-tests contrasted the agreement percentages and correlations for the groups. A scale-by-scale comparison of the three forms was also conducted. Correlations were computed for each test-retest administration.

Results

No order effects were observed, thereby allowing the combining of Group I and Group II data (P-M data) and also that of Groups IV and V (P-MRev data). Median tests of the distribution differences were conducted on the combined groups data, the results being summarized in Table 35. Table 35 shows that both Forms M and MRev were not sufficiently equivalent to Form P to pass all the tests to which they were subjected. Neither does Table 35 provide conclusive evidence for the superiority of one form over the other (i.e., Form M vs Form MRev). While Form MRev does better on the correlational analyses, it

Table 35

Summary of findings from median tests comparing distributions for Forms P, M, and MRev, by equivalence measure

	Equivalence measure	Type of Comparison		
		P-P vs P-M	P-P vs P-MRev	P-M vs P-MRev
1.	Percentage agreement, top 20 ORPs	NS[a]	.05[b]	NS
2.	Percentage agreement, bottom 20 ORPs	NS	NS	NS
3.	Average percentage agreement	.05	.05	NS
4.	Product moment correlation, ORPs	.01[c]	.01	NS
5.	Rank order correlation, ORPs	.01	NS	NS
6.	Product moment correlation, ORP clusters	.05	NS	NS
7.	Rank order correlation, ORP clusters	NS	NS	NS

[a]NS = Probability of $>$ .05 of rejecting median test null hypothesis.

[b].05 = Probability of $\leq$ .05 of rejecting median test null hypothesis.

[c].01 = Probability of $\leq$ .01 of rejecting median test null hypothesis.

fares worse on the percentage agreement analyses. However, Form MRev appears to be the better form in terms of equivalence with Form P.

Table 36 shows the cross-correlations for the scales from Forms M and MRev with the parallel Form P scales. Test-retest correlations for the Form P scales are also shown as a baseline for comparison. It appears from these data that neither Form M nor Form MRev is sufficiently equivalent to Form P, and furthermore, that the problem seems to lie with some of the same nine scales found earlier to lack equivalence. For Ability Utilization, Achievement, Supervision-Human Relations, and Working Conditions neither M nor MRev item wording was adequate. Form M wording was superior for Creativity and Responsibility, while Form MRev wording was superior for Recognition and Social Status, and slightly better for Moral Values.

However, it was felt that before attempting yet another revision, it was imperative to study the understandability of the Form M and Form MRev items to mentally retarded individuals. Such a study, it was felt, would provide better clues on how to revise the MIQ item stems.

MIQ Study 6

Understandability of Form M, Form MRev and Form P

Purpose

The purpose of this study was to determine the understandability of Form M, Form MRev and Form P of the MIQ. One method of determining understandability is through analysis of the total circular triad score (TCT). A circular triad is the choice of A over B, B over C, but C over A. Such choices represent a

Table 36

Cross-correlations for parallel scales from Forms P, M and MRev, by scale

Scale	Forms Paired		
	P-P	P-M	P-MRev
1. Ability Utilization	.72	.39	.47
2. Achievement	.88	.53	.67
3. Activity	.88	.83	.89
4. Advancement	.82	.73	.82
5. Authority	.88	.93	.81
6. Company Policies	.86	.70	.64
7. Compensation	.90	.86	.84
8. Co-Workers	.91	.85	.77
9. Creativity	.92	.70	.37
10. Independence	.88	.86	.78
11. Moral Values	.89	.72	.75
12. Recognition	.90	.39	.75
13. Responsibility	.86	.74	.62
14. Security	.80	.88	.85
15. Social Service	.89	.90	.91
16. Social Status	.92	.57	.77
17. Supervision-Human Relations	.89	.67	.59
18. Supervision-Technical	.82	.75	.72
19. Variety	.90	.86	.91
20. Working Conditions	.90	.68	.68

logically inconsistent (intransitive) response pattern. A TCT score is the total number of circular triads made in response to a pair comparison questionnaire. It can be reasoned that if a person understands the items, his TCT score should fall within a chance or "normal" range. Thus, understandability across the three forms could be ascertained by comparison of TCT scores. It is also possible to determine the contribution of each individual stimulus (item stem) to the TCT. This can be quantified in a stimulus circular triad score (SCT). Using SCT scores understandability of individual item stems can be compared across forms.

Method

Subjects--Mentally retarded subjects for this study consisted of 35 DVR clients who completed Form P in the WAP testing program, 21 Opportunity Workshop subjects who completed Form MRev, and 35 Anoka Sheltered Workshop subjects who also completed Form MRev. Data from the previous study (MIQ Study 5) were also analyzed in this study. These data were obtained from college sophomores in the experimental psychology pool.

Procedure--Each subject in the experimental psychology pool was administered Form P and one of the other two forms of the MIQ (Form M or Form MRev) in an immediate test-retest paradigm, as described in Study 5.

For each subject (mentally retarded as well as college sophomore), a TCT score and 20 SCT scores were computed. The mentally retarded samples were compared through one-way analyses of variance. Form P was compared with Forms M and MRev in the college sophomore group also through one-way analyses of variance. In both types of comparisons, it was expected that Form P would yield significantly higher TCT and SCT scores.

Results

No statistically significant differences for either TCT or SCT mean scores were observed between the DVR clients who had completed Form P and the two sheltered workshop samples that had completed Form MRev. Table 37 shows the data. However, the OWS group did have lower SCT means on 19 of the 20 scales and a lower TCT mean. The exception was on the Supervision-Human Relations scale. The Anoka group also had a lower TCT mean score and lower SCT mean scores on 14 of the 20 scales, the exceptions being Ability Utilization, Advancement, Creativity, Moral Value, Social Service and Supervision-Human Relations. (It is worth noting that four of these scales, Ability Utilization, Creativity, Moral Values and Supervision-Human Relations are among the nine for which equivalence was problematical.) These lower means notwithstanding, the statistical tests failed to confirm expectations. That is, the data did not provide any evidence (in terms of TCT and SCT scores) that Form MRev was more understandable than Form P. Likewise, the data for the experimental psychology pool subjects failed to yield evidence for more understandability of Form MRev or Form M.

MIQ Study 7

Construction of Form S

Purpose

Since previous studies showed specific weaknesses in both equivalence and understanding for both Forms M and MRev, it was decided to combine the two forms and construct a new form, Form S, (for "simplified") which represented the strengths of each.

Table 37

Means and standard deviations for stimulus circular triad (SCT) score, by scale, and total circular triad (TCT) score, for three mentally retarded groups

Scale	Group[a] DVR(N=35)		OWS(N=21)		ASW(N=35)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
1. Ability Utilization	26.2	11.9	21.8	15.4	26.5	14.5
2. Achievement	28.8	13.0	20.7	14.9	26.7	15.9
3. Activity	27.5	14.4	20.0	13.7	24.6	14.1
4. Advancement	26.8	14.5	22.3	14.6	27.1	12.9
5. Authority	24.6	17.2	19.3	18.5	23.7	18.2
6. Company Policies	29.4	13.9	20.8	13.0	28.5	15.3
7. Compensation	28.6	12.5	22.2	14.0	24.0	14.9
8. Co-Workers	29.6	13.1	23.6	11.8	27.7	13.4
9. Creativity	27.2	13.8	20.1	13.0	29.5	14.7
10. Independence	24.3	14.6	23.9	16.8	23.5	13.4
11. Moral Values	26.1	14.3	22.8	14.6	26.5	17.1
12. Recognition	29.0	12.5	20.9	16.1	25.5	13.8
13. Responsibility	29.8	15.4	21.9	14.7	26.1	17.1
14. Security	26.9	13.9	21.3	14.4	24.2	15.3
15. Social Service	24.1	13.5	21.8	16.3	27.1	16.0
16. Social Status	25.5	12.6	20.1	16.0	22.9	15.2
17. Supervision-Human Relations	25.4	14.0	25.7	15.5	25.6	14.4
18. Supervision-Technical	28.4	14.1	23.4	12.3	24.7	15.2
19. Variety	27.7	14.5	20.8	14.5	25.9	16.7
20. Working Conditions	29.7	12.7	21.8	14.2	26.8	14.5
Total Circular Triad	196.9	76.2	151.8	88.0	177.4	90.9

[a] DVR= Minnesota Division of Vocational Rehabilitation clients who completed Form P
OWS= Opportunity Workshop employees who completed Form MRev
ASW= Anoka Sheltered Workshop employees who completed Form MRev

Method

Before proceeding with the construction of Form S, the readability of Forms P, M and MRev was determined, employing the Dale-Chall and Flesch formulas. This readability analysis provided additional data on which to base Form S. The findings from the various equivalence and understandability studies were summarized and collated. Decision rules were adopted for the choice of item stems.

Results

Table 38 shows the findings of the readability analyses. These findings were combined with those of the preceding studies on equivalence and understandability. The choice of item stems for Form S was based on the following rules: (a) Form P item stems were to be preferred if they met the criterion of understandability (a Dale-Chall score of less than 5.0 and/or a Flesch score of greater than 80); (b) Form M or MRev item stems were to be chosen if they met the criterion of understandability and equivalence (no statistically significant difference from Form P in the various equivalence studies); and (c) Form M or MRev item stems that met the criterion of understandability but not equivalence would be included if they met the added criterion of importance (at least two-thirds of the mentally retarded subjects indicate that they felt these aspects were important in their ideal job.) Table 39 shows the scales which failed to meet the importance criterion. Table 40 summarizes the results of the application of these decision rules.

Table 40 shows that four item stems from any form (for Authority, Moral Values, Social Status and Working Conditions) failed to meet the criterion of understandability. In addition, Authority, Moral Values and Social Status failed to

Table 3[8]

Dale-Chall and Flesch readability scores for Forms P, M, and MRev, by scale

Scale	Dale-Chall[a]			Flesch[b]		
Form	P	M	MRev	P	M	MRev
1. Ability Utilization	5.7	4.2	4.2	78	95	95
2. Achievement	5.8	6.2	4.0	76	84	85
3. Activity	4.0	4.0	4.0	100	100	100
4. Advancement	9.8	4.0	4.0	40	100	100
5. Authority	4.0	4.0	4.0	100	100	100
6. Company Policies and Practices	10.6	4.0	4.0	20	100	100
7. Compensation	4.1	4.1	4.1	86	85	85
8. Co-workers	5.8	4.0	4.0	85	93	93
9. Creativity	4.1	4.3	4.3	100	93	93
10. Independence	4.0	4.0	4.0	100	100	100
11. Moral Values	5.5	5.8	4.1	82	86	86
12. Recognition	5.8	4.2	4.2	85	85	86
13. Responsibility	6.2	4.2	4.2	91	59	59
14. Security	10.6	6.6	6.6	64	100	100
15. Social Service	4.0	4.0	4.0	91	91	91
16. Social Status	8.4	4.0	4.0	57	21	22
17. Supervision-Human Relation	8.8	4.0	4.0	95	98	98
18. Supervision-Technical	4.0	4.2	4.2	100	100	100
19. Variety	4.0	4.0	4.0	67	67	67
20. Working Conditions	6.2	4.2	5.6	80	67	68

a
Dale-Chall scores correspond to grade level.

b
Flesch scores are interpreted as follows:

0-30	College	Very difficult
30-50	High school or some college	Difficult
50-60	Some high school	Fairly difficult
60-70	7th-8th grade	Standard
70-80	6th grade	Fairly easy
80-90	5th grade	Easy
90-100	4th grade	Very easy

Table 39

Scales failing to meet criterion of importance, by form

Form	N[a]	Scale	% "Not important"
MRev	60	5. Authority	62
		9. Creativity	35
		11. Moral Values	47
		16. Social Status	42
		19. Variety	42
P	34	5. Authority	74
		9. Creativity	38
		10. Independence	47
		11. Moral Values	38
		13. Responsibility	41
		16. Social Status	38
		17. Supervision-Human Relations	44

[a] All subjects were mentally retarded individuals.

meet the criterion of understandability. In addition, Authority, Moral Values and Social Status failed to meet the criterion of importance. It was therefore decided to drop these three scales from consideration for Form S. A new item stem was written for Working Conditions. Item stems for the other 16 scales were chosen as indicated in Table 40. The item stems used in constructing Form S are listed in Table 41. A copy of the instrument itself is included in Appendix B.

MIQ Study 8

Equivalence of Form S and Form P

Purpose

This study was conducted to examine the equivalence between the new form, Form S, and the standard form, Form P. Equivalence was to be analyzed in terms of two criteria: profile similarity and parallel scale comparability.

Method

Subjects--Subjects for this study were 233 CLA students at the University of Minnesota.

Procedure--The subjects were randomly assigned to one of four experimental groups and administered two forms of the MIQ in a one-week test-retest format. The three forms of the MIQ used in the experiment were: (a) Form S, the 17-scale revision (Study 7); (b) Form P, the standard form; and (c) Form PS, a 17-scale experimental instrument which paralleled Form S in format but utilized Form P item stems.

Table 40
Choice of item-stem wording for Form S
and reason for choice, by scale

	Scale	Form Chosen	Reason for choice: Equivalence	Reason for choice: Understandability
1.	Ability Utilization	MRev		x
2.	Achievement	MRev	x	x
3.	Activity	M/MRev[a]	x	x
4.	Advancement	M/MRev	x	x
5.	Authority			
6.	Company Policies	M/MRev		x
7.	Compensation	M/MRev	x	x
8.	Co-Workers	M/MRev		x
9.	Creativity	P	x	x
10.	Independence	P	x	x
11.	Moral Values			
12.	Recognition	MRev	x	x
13.	Responsibility	P	x	x
14.	Security	M/MRev	x	x
15.	Social Service	P	x	x
16.	Social Status			
17.	Supervision-Human Relations	M	x	x
18.	Supervision-Technical	P	x	x
19.	Variety	P	x	x
20.	Working Conditions			

[a] Item stems are identical for Forms M and MRev.

Table 41

Item stems for MIQ

Form S, by scale

	Scale	Item Stem
1.	Ability Utilization	You could do the kind of work that you do best.
2.	Achievement	The job could make you feel useful.
3.	Activity	You could be busy all the time.
4.	Advancement	You could move up to a better job.
5.	Company Policies	The people you work for would be fair.
6.	Compensation	You could make as much money as other workers.
7.	Co-Workers	The people you work with would be friendly.
8.	Creativity	You could try out some of your own ideas.
9.	Independence	You could work alone on the job.
10.	Recognition	You could get praise and credit for the work you do.
11.	Responsibility	You could make decisions on your own.
12.	Security	You would have a steady job.
13.	Social Service	You could do things for other people.
14.	Supervision-Human Relation	Your boss would back up his men.
15.	Supervision-Technical	Your boss would train his men well.
16.	Variety	You could do something different every day.
17.	Working Conditions	The place you work would be clean and comfortable.

The four experimental groups were: (a) Form S administered at Time 1 and 2 (N=64); (b) Form S or Form P at Time 1 and the other form at Time 2 (N=54); (c) Form P or Form PS at Time 1 and the other form at time 2 (N=55); and (d) Form S or Form PS at Time 1 and the other form at Time 2 (N=60). Order of administration was randomized within each of the latter three groups.

Analysis--For each S, rank order and product moment correlations were computed between the two forms for the ORP and ORP cluster rankings. (These ORP rankings were obtained by comparing the S's MIQ profile with the ORPs and obtaining a measure of correspondence between MIQ profile and each ORP or ORP cluster.) Agreement percentages were obtained for the top-ranked 20 and bottom ranked 20 ORPs. An average agreement was also computed. These constituted the seven measures of equivalence used to evaluate Form S.

Frequency distributions for each of the seven equivalence measures were plotted by experimental group. These distributions were then compared between groups and tested by median tests.

For each experimental group, scale test-retest correlations were obtained and compared with those of other groups, using Fisher's z transformation method.

Results

Data on the seven measures of equivalence are summarized in Table 42, which presents medians for each group. These data show that Form S is an adequate psychometric instrument insofar as ORP profile stability is concerned. The correlation coefficients ranged from .88 to .91, while percentage agreement

Table 42

Median equivalence measure,
by group

Equivalence measure	Group[a] A(N=64)	B(N=54)	C(N=55)	D(N=60)
1. Percentage agreement, top 20 ORPs	75%	65%	60%	75%
2. Percentage agreement, bottom 20 ORPs	80%	70%	65%	80%
3. Average percentage agreement	78%	65%	60%	75%
4. Product moment correlation, ORPs	.90	.78	.74	.91
5. Rank order correlation, ORPs	.88	.75	.73	.89
6. Product moment correlation, ORP clusters	.91	.85	.75	.91
7. Rank order correlation, ORP clusters	.90	.80	.67	.87

[a] A = Form S, followed by Form S

B = Form S or P, followed by the other form

C = Form P or PS, followed by the other form

D = Form S or PS, followed by the other form

was 75% or better.

The group comparisons of particular interest in this study were: A vs. B (S-S vs.S-P) and C vs. D (S-PS vs. P-PS), both of which compare Form S with Form P; and A vs. D (S-S vs.S-PS) and B vs. C (P-S vs. P-PS), both of which compare Form S with Form PS. The results of the median tests for these group comparisons are shown in Table 43. As Table 43 shows, the analysis revealed a difference between Form S and Form P but not between Form S and Form PS. This may be the result of leaving out three scales from Form S.

Scale test-retest correlations are shown for each experimental group in Table 44. Again, Form S appears to be an adequate instrument in terms of test-retest reliability. Only two scales, Ability Utilization and Achievement, have coefficients lower than .70.

Data on the group comparisons of interest to this study are shown in Table 45. These data confirm the previous findings that Form S differs from Form P principally because of the absence of three scales. Table 45 also casts some doubt on the equivalence (to Form P) of the following Form S scales: Ability Utilization, Achievement, Activity, Company Policies, Compensation and Creativity.

As a final conclusion, Form S appears to be an adequate psychometric instrument from the view point of test-retest reliability, but should be interpreted in terms of ORP profiles rather than on a scale by scale basis. At this (profile) level, Form S is equivalent to Form P.

Table 43

Results of median tests of equivalence measure distributions, by group

Equivalence measure	Comparison[a]			
	A vs. B	C vs. D	A vs. D	B vs. C
1. Percentage agreement, top 20 ORPs	NS[b]	.01[d]	NS	NS
2. Percentage agreement, bottom 20 ORPs	.05[c]	.01	NS	NS
3. Average percentage agreement	.05	.01	NS	NS
4. Product moment correlation, 81 ORPs	.05	.01	NS	NS
5. Rank order correlation, 81 ORPs	.05	.01	NS	NS
6. Product moment correlation, ORP clusters	.05	.01	NS	NS
7. Rank order correlation, ORP clusters	NS	NS	NS	NS

[a] A = Form S, followed by Form S

B = Form S or P, followed by the other form

C = Form P or PS, followed by the other form

D = Form S or PS, followed by the other form.

[b] NS = Probability of rejecting null hypothesis > .05

[c] .05 = Probability of rejecting null hypothesis ≤ .05

[d] .01 = Probability of rejecting null hypothesis ≤ .01

Table 44

Test-retest correlations (one-week interval) for four experimental groups, by scale

Scale	Group[a] A(N=64)	B(N=54)	C(N=55)	D(N=60)
1. Ability Utilization	.62	.11	.70	.53
2. Achievement	.69	.19	.67	.41
3. Activity	.85	.82	.81	.71
4. Advancement	.77	.81	.83	.78
5. Company Policies	.75	.60	.72	.53
6. Compensation	.86	.80	.79	.82
7. Co-Workers	.78	.73	.79	.73
8. Creativity	.89	.76	.91	.71
9. Independence	.83	.76	.86	.78
10. Recognition	.85	.84	.83	.81
11. Responsibility	.76	.71	.89	.84
12. Security	.77	.86	.85	.88
13. Social Service	.85	.86	.86	.79
14. Supervision-Human Relations	.81	.54	.70	.65
15. Supervision-Technical	.82	.67	.74	.70
16. Variety	.85	.72	.69	.75
17. Working Conditions	.71	.56	.53	.52

[a] A = Form S, followed by Form S

B = Form S or P, followed by the other form

C = Form P or PS, followed by the other form

D = Form S or PS, followed by the other form

Table 45

Results of tests for differences between test-retest correlations for groups, by scale

Scale	Comparison[a]			
	A vs. B	C vs. D	A vs. D	B vs. C
1. Ability Utilization	.01[b]	NS	NS	.01[d]
2. Achievement	.01	.05[c]	NS	.01
3. Activity	NS	NS	.05	NS
4. Advancement	NS	NS	NS	NS
5. Company Policies	.05	NS	.05	NS
6. Compensation	.01	NS	NS	.01
7. Co-Workers	NS	NS	NS	NS
8. Creativity	.01	NS	.01	NS
9. Independence	.05	NS	NS	NS
10. Recognition	.05	NS	NS	NS
11. Responsibility	NS	NS	NS	NS
12. Security	NS	NS	NS	NS
13. Social Service	.05	NS	NS	NS
14. Supervision-Human Relations	.01	NS	NS	NS
15. Supervision-Technical	NS	NS	NS	NS
16. Variety	NS	NS	NS	NS
17. Working Conditions	NS	NS	NS	NS

[a]A = Form S followed by Form S
B = Form S or P, followed by the other form
C = Form P or PS, followed by the other form
D = Form S or PS, followed by the other form
[b]NS = Probability of rejecting null hypothesis $>$ .05
[c].05 = Probability of rejecting null hypothesis $\leq$ .05
[d].01 = Probability of rejecting null hypothesis $\leq$ .01

Summary of Pesults

The results of the separate studies described in the preceding section (Methodology) may be summarized as follows:

1. Provision of extra practice and the elimination of answer sheets contributed to improved ability test performance on non-mentally-retarded individuals, but did not appear to be of any demonstrable added benefit to the mentally retarded. (GATB Study 1).
2. The mentally retarded group obtained the lowest mean scores among the groups tested, but it generally showed just as much variability in scores as the other groups. (GATB Studies 1, 2, 4).
3. For all groups, including the mentally retarded, "wrong" scores (scoring the items answered incorrectly) were found to correlate only slightly, or not at all, with "right" scores (number of items answered correctly). The mentally retarded showed the largest variability in "wrong" scores. (GATB Studies 1, 4).
4. Ability test intercorrelations, for all groups including the mentally retarded, tended to range from moderate to high when "right" scores were used. In contrast, when "wrong" scores were used, intercorrelations among abilities tended to range from moderate to low. (GATB Studies 1, 4)
5. The pattern of relationships (intercorrelations) among abilities for the mentally retarded groups was similar to those of non-mentally-retarded groups. (GATB Studies 1, 4).
6. Individual administration (as opposed to group administration) and the removal of time limits did not contribute to the improvement of ability test performance for the mentally retarded group. When an "accuracy" score was used (number right per set of items, with either total number attempted or first twenty items attempted as

the two different item sets), most groups generally did better under the timed condition than under the untimed condition. This finding was most pronounced for the mentally retarded groups, and especially for its performance on the Vocabulary test. (GATB Study 2).

7. The removal of "verbally loaded" (correlated with verbal ability) items improved the performance of the mentally retarded on the Three-Dimensional Space and Arithmetic Reasoning tests, but not on the Name Comparison, Computation, Tool Matching and Form Matching tests. (GATB Study 3).
8. Simplifying test instructions and simplifying practice problems did not help improve the test performance of the mentally retarded. (GATB Study 4).
9. A not-surprising finding was that level of general mental ability (in comparison with other factors involving modification of the GATB) was the overriding factor in determining variance in ability test performance. (GATB Studies 1, 2, 4).
10. Mentally retarded individuals responded meaningfully (logically and non-randomly) to MIQ-type instruments. Their responses differed in means and variances from those of non-mentally-retarded subjects. Nonetheless, individual differences among the mentally retarded were clearly in evidence. (MIQ Study 1).
11. MIQ item stems were written which, with a few exceptions, were judged by professional workers in the field of mentally retarded clients. (MIQ Study 2). Many of these same item revisions of the MIQ produced similar results (means and standard deviations) as the regular form (Form P) for a group of non-mentally-retarded DVR clients. (MIQ Study 1).
12. Test-retest equivalence was obtained for 11 scales of an initial

revised version of the MIQ for use with the mentally retarded (Form M). These equivalent scales were: Activity, Advancement, Authority, Company Policies and Practices, Compensation, Co-Workers, Independence, Security, Social Service, Supervision-Technical, and Variety. However, equivalence was not demonstrated for Form M when test and retest profiles were correlated. (MIQ Study 3).

13. Item stems rewritten for the 9 non-equivalent scales of Form M were found to be "readable" at the 4th to 5th grade level using the Dale-Chall and Flesch formulas. These rewritten scales, together with the 11 scales previously found to be equivalent, constituted Form MRev. (MIQ Study 4).

14. Form MRev was not found to be demonstrably superior to Form M in terms of equivalence with Form P. Form MRev was superior on correlational measures of equivalence (correlating measures of correspondence with ORPs) but inferior on agreement measures (percentage of agreement for top-ranked and bottom-ranked ORPs). (MIQ Study 5).

15. By choosing the best item stems from Form M, Form MRev and Form P, (based on the criteria of equivalence to Form P), understandability (readability), and importance (to at least two-thirds of mentally retarded respondents), a new 17-scale form was constructed (Form S). (MIQ Studies 6,7).

16. Form S was found to be equivalent (on all seven equivalence measures) to a parallel 17-scale Form P but not to the full 20-scale Form P. Scale equivalence was found for 11 of the 17 Form S scales, the exceptions being Ability Utilization, Achievement, Activity, Company Policies and Practices, Compensation and Creativity. (MIQ Study 8)

17. Form S was found to have adequate test-retest reliability (one-week interval) at both the profile and the scale level. Only two scales, Ability Utilization and Achievement, had test-retest reliability coefficients lower than .70 (MIQ Study 8).

Discussion and Implications

There are abundant data from the preceding studies to support the conclusion that individual differences in vocational abilities and vocational needs are to be found among mentally retarded individuals categorized as "mild" or "borderline" (those with IQs of 55 and higher). Furthermore, the data show that these individual differences extend in a range similar to that of the non-mentally-retarded, even if their (mentally retarded) average level is below that of the non-mentally-retarded on ability tests and different from that of the non-mentally-retarded on need scales. The data also show that these individual differences are reliable and that similar patterns of inter-relationships among abilities and among needs obtain for mentally retarded as for non-mentally-retarded groups.

These facts about the mentally retarded are consistent with the assumptions of the Theory of Work Adjustment, and therefore an application of the theory for mentally retarded individuals should be feasible. That is, the prediction of work adjustment, tenure, satisfactoriness and satisfaction for the mentally retarded should be possible from an assessment of their abilities and needs, and from a determination of the correspondence of their abilities with ability requirements for jobs (e.g., OAPs) and the correspondence of reinforcer systems for jobs (e.g., ORPs) with their needs. Such correspondence-determination could conceivably reveal,as possibilities for the mentally retarded, areas in the world of work which heretofore have not been considered in vocational rehabilitation counseling with the mentally retarded. A full-scale determination of the range of work environments for which a mentally retarded individual would be predicted to be satisfactory and satisfied , accomplished in this fashion, would be a more thorough, more precise and more objective assessment of the individual's "work potential" than ordinarily can be gained under methods currently in use.

Furthermore, such application of the Theory of Work Adjustment would contribute toward the individualization of treatment of mentally retarded persons, thereby helping destroy the stereotypy in attitudes and expectations about the mentally retarded that are held by many people, unfortunately even by some professional workers in the field of mental retardation.

The findings concerning the GATB strongly support the feasibility of a multi-dimensional (multifactor) approach to the assessment of "vocational potential" (work potential) in mentally retarded individuals. This approach contrasts sharply with, on the one hand, the IQ approach (wherein the IQ is the basic determiner of the range of work possibilities to be considered for the individual) and, on the other hand, the work sample approach (wherein vocational rehabilitation counseling is based on work try-out experience). In the latter approaches, the range of work possibilities that can be considered are limited--by invalidity of the IQ in its lower ranges as a predictor of job success, and by time and space constraints on the number of work samples that any one individual can attempt to try out.

Little success was attained, in the research reported here, in modifying the GATB to "improve" the ability test performance of mentally retarded individuals. The removal of separate answer sheets, increase in the number of practice problems, individual administration, non-speeded (untimed) administration, deletion of "verbally loaded" items, simplification of test instructions and practice problems did not appear to provide any demonstrable added benefit for the mentally retarded. This lack of success might be interpreted as indicating the need to develop a new battery of ability tests for the mentally retarded, one in which the upper ranges of the new tests would coincide with the lower ranges of the GATB tests. Alternatively, the current GATB tests could be modified in content to extend their lower score ranges downward.

A different interpretation of this same lack of success is that for mentally retarded individuals in the higher categories (e.g., "borderline") it may not at all be necessary to modify the GATB. That is, the current GATB can be administered in the standard manner and still be useful in vocational assessment and vocational rehabilitation counseling with some mentally retarded individuals.

While the data reported here provide no evidence that ability test performance of the mentally retarded,as a group, can be improved by the modifications introduced, it cannot be concluded that testing conditions have little or no effect on the test performance of mentally retarded individuals. It can be shown that some individuals did better under a given test condition, while others did worse. Future research should address itself to the problem of determining how to predict which individuals would profit from which testing-condition modification, i.e., what "moderator variables" are involved in test administration. In the meantime, no harm can be done by optimizing test administration conditions for the mentally retarded.

An important finding from the GATB research was the low correlation between "wrong" scores (the number of items answered incorrectly) and "right" scores (the number of items answered correctly). This finding indicates that "wrong" scores may yield information not contained in the conventional "right" scores. If these "wrong" scores prove to be reliable, they may become useful measures of individual differences in ability among the mentally retarded.

This finding (of low correlation between "right" and "wrong" scores) also suggests the potential utility of "speed" and "accuracy" scores. "Speed" scores (total number of items attempted) and "accuracy" scores (ratio of number of items answered correctly to total number attempted) are derived from and related to "right" and "wrong" scores, but may have different meanings or validities. It is plausible to expect such scores to be related to work performance, if not to work adjustment.

Because of their potential importance, normative data on these different kinds of scores are included in this report. Appendix A presents percentile tables of "right" scores, "wrong" scores, "speed" scores and "accuracy" scores, in four GATB tests (Name Comparison, Computation, Vocabulary and Tool Matching), for the group of 167 mentally retarded employees of seven sheltered workshops who were the subjects for GATB Study 4. An intercorrelation table is also included in Appendix A.

With respect to the MIQ, it can be concluded that a modest start has been made on developing an equivalent form of the MIQ (a measure of vocational needs) for use with mentally retarded individuals. Form S appears to be ready for extended experimental tryout with individuals in the "borderline", and perhaps even the "mild", category. As MIQ Study 8 indicates, profile interpretation can be undertaken with some confidence, but scale interpretation should proceed with caution or not be undertaken at all.

Much development work remains to be done. Several scales require improvement to meet the criteria of understandability and/or equivalence with the corresponding standard form MIQ scales. Questionnaire administration conditions have to be studied, e.g., comparison of administration media (paper-and-pencil vs. tape vs. card sorting). Direct determination of reliability and validity have to be undertaken. (There are some data on reliability, e.g., one-week test-retest, but validity has been assumed to be equivalent to that of the standard form MIQ.) These developmental requirements notwithstanding, Form S represents a significant advance in the measurement of the vocational needs of mentally retarded persons.

The major conclusions from this research project, then, are the following:

1. That the work personalities of the mentally retarded are complex and varied, i.e., multidimensional and spanning a large range of individual differences;

2. that the work personalities of the mentally retarded can be assessed objectively, or more specifically, can be measured; and,

3. that the measurement of the work personalities of the mentally retarded, specifically the measurement of vocational abilities and vocational needs, can be accomplished in such a manner as to obtain information that is equivalent to information currently used with the non-mentally-retarded. This development, in turn, would allow, in due time, the profitable application of the extensive body of knowledge about work and work adjustment concerning the non-mentally-retarded to the vocational problems of the mentally retarded individuals.

Summary

Application of the Theory of Work Adjustment in vocational rehabilitation practice depends on the feasibility of assessing the work personalities of individuals (especially their work-relevant abilities and needs) and of describing work environments in work personality terms. In this context, the General Aptitude Test Battery (GATB) and the Minnesota Importance Questionnaire (MIQ) are two of the more useful measures of work personality (of vocational abilities and vocational needs, respectively), because of the availability, for a wide variety of occupations, of Occupational Aptitude Patterns (OAPs) which describe work environments in GATB terms, and of Occupational Reinforcer Patterns (ORPs) which describe work environments in MIQ terms.

This project was premised on the belief that mentally retarded individuals have unique work personalities and that the assessment of their work personalities in the manner indicated by the Theory of Work Adjustment will enable the application of the theory in the vocational rehabilitation of these individuals. For this reason, one major objective of the project was to modify or revise the GATB and the MIQ for use with mentally retarded individuals, and to accomplish these revisions in such a manner as to retain psychometric equivalence with the standard GATB and MIQ forms.

Two groups of mentally retarded individuals participated in the various project studies. One group consisted of employees in several sheltered workshops in Minnesota. The second group consisted of clients of the Minnesota Division of Vocational Rehabilitation (DVR). Mental ability scores for these mentally retarded subjects showed that a large proportion of them could be categorized as "borderline" while a smaller proportion were best categorized as "mild".

Other groups of non-mentally-retarded individuals were utilized as comparison groups for the mentally retarded, or as groups on which psychometric equivalence studies were conducted. These included groups of non-mentally retarded DVR clients, high school students, general college (non-degree) students, and College of Liberal Arts students (the latter two groups at the University of Minnesota).

Rather than revise the content of the GATB tests, it was thought that modifying test administration procedures would enable the meaningful use of these tests with mentally retarded persons. Consequently a series of studies was conducted to investigate the effects of the following test administration modifications: (a) eliminating the separate answer sheet; (b) increasing the number of practice problems; (c) individual (vs. group) administration of the GATB tests; (d) administering the tests under untimed conditions; (e) eliminating items that correlate significantly with verbal ability; (f) simplifying test instructions and directions; and (g) simplifying practice problems. None of these modifications was found consistently to exert any significant influence on the test performance of the mentally retarded subjects. One might conclude that the GATB as presently administered can yield useful work-personality information about mentally retarded individuals in the higher IQ ranges (the "borderline" category). Individuals in the "mild" or lower categories would be better served by a new ability test battery which would have to be constructed in such a way as to calibrate with the GATB.

Several observations could be made about the ability test performance of the mentally retarded. While the group's average score on every GATB test used was uniformly lower than "normal", the variability in the group's test scores equalled or approximated that of the non-mentally retarded on all tests with

the lone exception of the vocabulary (verbal ability) test. Furthermore, the pattern of relationships among abilities (as indicated by test intercorrelations) was found to be similar for mentally retarded and non-mentally-retarded groups. These findings lead to the conclusion that a variety of work personality "types" can be expected to be found among the mentally retarded as among the non-mentally-retarded.

The finding that "wrong" scores (scoring the items answered incorrectly) correlated lowly with the conventional "right" scores lends credence to the utility of "speed" scores (number of items attempted) and "accuracy" scores (proportion correct of number attempted). Utility of these kinds of scores as measures of work personality, and in the prediction of work adjustment and vocational success, is worthy of future attention by vocational psychologists.

In contrast to the GATB, revision of the MIQ was attempted through a revision of item content. A series of studies was conducted to successively approximate the desired levels of understandability by mentally retarded subjects and psychometric equivalence with the standard MIQ. Understandability was based on judgments by professional workers in the mental retardation field, by readability studies, and by clinical interviews with mentally retarded subjects. Psychometric equivalence was ascertained at the profile level as well as the scale level. This included determination of similarity of score profiles generated by revised and standard MIQs, similarity of correspondence of these profiles with ORPs, and similarity in scale means and scale variances. The final revision of the MIQ in this series of studies did not include three scales rated as not important by more than a third of the mentally retarded subjects. This final revision was found, by the various tests, to be equivalent to an equivalent (i.e., 17-scale) version of the standard MIQ. However, while many of its scales were equivalent, several scales were not found to be equivalent to the corresponding standard-form scales. Hence

interpretation of scores from the revised form is warranted at the profile level, but can only be done with caution at the scale level.

The data from the MIQ studies show conclusively that individual differences in vocational needs are to be found among the mentally retarded as among the non-mentally retarded. That these individual differences in vocational needs have vocational significance is evident from the equivalence studies, especially where profile correspondence with ORPs was used as the criterion of equivalence. Thus, these studies demonstrate the feasibility and the utility of assessing not only the vocational abilities but also the vocational needs of the mentally retarded.

The results of this project should serve to lend strong support to those who insist on an individualized approach to the vocational rehabilitation of the mentally retarded and to those who seek to break away from the stereotyped thinking and attitudes that in the past have handicapped programs for these individuals.

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Appendixes

		Page
Appendix A	GATB Percentile Norms and Intercorrelations	106
Appendix B	Copy of Minnesota Importance Questionnaire (MIQ-Form S)	123

Appendix A

Table A-1

Name Comparison Speed Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	35	55.7
2	1.2	36	58.1
5	3.0	37	59.9
8	4.2	38	62.3
9	6.0	39	62.9
10	7.2	40	62.5
11	8.4	41	65.3
13	9.6	42	67.1
14	11.4	44	70.1
15	12.0	45	73.1
16	13.2	46	73.7
17	15.0	47	79.0
18	15.6	48	80.8
19	16.8	49	82.6
20	19.2	50	84.4
21	22.8	51	89.2
22	24.0	52	89.8
23	25.7	53	90.4
24	26.9	54	91.6
25	28.7	55	92.2
26	31.1	57	92.8
27	32.9	58	93.4
28	36.5	63	94.0
29	38.3	67	94.6
30	38.9	68	95.8
31	44.9	70	97.0
32	47.3	74	97.6
33	51.5	75	98.8
34	53.9	79	99.4

Mean 33.63
Standard Deviation 16.38

Table A-2

Name Comparison Right Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	30	61.7
1	1.2	31	64.7
2	3.0	32	66.5
3	4.2	33	67.7
4	5.4	34	68.9
6	6.6	35	70.1
7	8.4	36	72.5
8	10.2	37	74.9
9	10.8	38	75.4
10	12.6	39	76.0
11	13.2	40	77.2
12	14.4	41	79.0
13	15.6	42	81.4
14	17.4	43	83.8
15	20.4	44	85.0
16	24.6	45	86.2
17	25.7	46	87.4
18	28.7	47	89.2
19	31.1	48	89.8
20	33.5	49	91.0
21	35.9	51	91.6
22	37.7	52	92.8
23	40.1	53	93.4
24	43.1	54	94.6
25	46.7	56	95.2
26	52.1	58	95.8
27	53.9	59	97.0
28	56.3	64	97.6
29	58.7	69	98.2
		77	99.4

Mean 27.16
Standard Deviation 15.45

Table A-3

Name Comparison Wrong Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	12	80.2
1	7.2	13	85.0
2	18.0	14	88.0
3	29.3	15	91.0
4	40.1	16	91.6
5	45.5	17	94.6
6	54.5	18	95.8
7	62.3	19	96.4
8	66.5	20	97.0
9	70.1	21	98.2
10	72.5	23	98.8
11	77.2	32	99.4

Mean 6.47
Standard Deviation 5.63

Table A-4

Name Comparison Accuracy Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	72	37.1
12	1.2	73	37.7
34	1.8	75	40.7
36	2.4	76	43.7
37	3.0	77	44.9
39	3.6	78	46.7
41	4.2	79	47.9
44	4.8	80	49.7
46	5.4	81	50.9
47	6.0	82	51.5
50	6.6	83	52.7
53	11.4	84	54.5
55	12.6	85	55.7
56	13.2	86	58.1
57	15.0	87	59.3
59	15.6	88	61.7
61	19.2	89	62.3
63	19.8	90	64.1
64	21.6	91	65.9
65	22.2	92	70.1
66	22.8	93	74.9
67	25.7	94	79.0
68	29.3	95	81.4
69	31.7	96	88.0
70	34.1	97	91.0
71	34.7	98	93.4
		100	94.0

Mean 76.62
Standard Deviation 19.37

Table A-5

Computation Speed Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	16	56.0
1	4.8	17	49.1
2	5.4	18	66.5
3	9.0	19	68.9
4	12.0	20	74.0
5	15.6	21	76.0
6	19.2	22	79.6
7	20.4	23	81.4
8	24.0	24	86.6
9	26.9	25	89.2
10	29.9	26	89.9
11	33.5	27	93.4
12	38.3	28	95.2
13	46.1	29	96.8
14	48.5	30	96.4
15	53.3	31	98.2
		35	99.4

Mean 14.01
Standard Deviation 8.12

Table A-6

Computation Math Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	14	71.3
1	7.2	15	73.1
2	11.4	16	77.2
3	17.4	17	80.0
4	24.6	18	86.2
5	29.9	19	88.0
6	37.1	20	89.8
7	43.7	21	91.0
8	47.9	22	92.8
9	53.3	23	95.2
10	55.1	24	95.8
11	60.5	25	96.4
12	66.5	26	98.2
13	67.1	28	98.8

Mean 9.44
Standard Deviation 7.07

Table A-7

Computation Wrong Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	10	86.8
1	16.8	11	89.9
2	29.9	12	91.6
3	47.3	13	92.2
4	58.7	15	93.9
5	65.9	17	95.2
6	71.9	20	95.8
7	75.6	21	97.6
8	78.4	23	98.2
9	84.4	24	99.4
		29	99.4

Mean 4.57
Standard Deviation 5.26

Table A-8

Computation Accuracy Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	63	39.9
6	7.2	64	39.5
7	7.8	65	40.1
8	8.4	66	40.7
13	9.6	69	45.5
14	10.2	69	46.7
17	11.4	71	47.3
21	12.0	72	49.1
22	12.6	73	50.3
23	13.2	74	51.5
25	14.4	75	52.1
27	18.6	76	53.9
28	19.2	77	56.3
29	20.4	78	58.1
33	21.0	79	59.9
35	22.2	80	61.7
36	22.8	81	62.3
37	23.4	83	63.1
38	24.6	86	67.1
42	25.1	85	68.9
45	25.7	86	70.1
46	26.3	87	71.9
47	26.9	88	72.5
50	27.5	89	75.4
51	31.7	90	76.6
53	32.3	91	77.8
55	32.9	92	81.4
56	33.5	93	83.2
57	34.1	94	85.6
59	35.9	96	87.4
62	37.1	100	89.0

Mean 63.11
Standard Deviation 30.97

Table A-9

Vocabulary Speed Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	21	68.9
1	7.8	22	70.1
2	10.2	23	72.5
3	13.2	24	75.4
4	15.6	25	77.2
5	16.8	26	79.6
6	22.8	27	80.2
7	26.3	28	83.2
8	28.1	29	83.8
9	32.3	30	86.2
10	35.9	31	88.0
11	38.3	32	89.2
12	40.7	33	91.6
13	43.1	35	92.8
14	44.9	39	93.4
15	47.3	40	94.6
16	51.5	41	95.8
17	55.7	46	97.0
18	59.3	48	97.6
19	61.1	49	98.2
20	65.3	54	98.8
		57	99.4

Mean 16.18
Standard Deviation 12.18

Table A-10

Vocabulary Right Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	12	76.0
1	15.0	13	79.6
2	23.4	14	83.2
3	29.9	15	86.8
4	37.1	16	90.4
5	41.9	17	92.2
6	48.5	18	93.4
7	55.1	19	94.6
8	57.5	20	95.2
9	62.3	24	97.0
10	69.5	25	97.6
11	72.5	26	98.8
		27	99.4

Mean 7.11
Standard Deviation 6.30

Table A-11

Vocabulary Wrong Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	16	81.4
1	10.2	17	83.8
2	18.0	18	84.4
3	24.0	19	85.6
4	29.3	20	88.0
5	36.5	21	89.2
6	44.9	22	91.0
7	52.1	23	92.2
8	55.7	24	92.8
9	59.9	26	93.4
10	65.9	27	94.0
11	68.3	28	95.2
12	70.1	31	95.8
13	72.5	34	97.0
14	75.4	36	98.2
15	80.2	39	98.8
		48	99.4

Mean 9.07
Standard Deviation 8.85

Table A-12

Vocabulary Accuracy Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	44	58.7
6	15.0	46	59.9
9	16.2	47	60.5
10	18.0	50	61.7
12	18.6	52	65.9
14	19.8	53	66.5
15	20.4	56	67.7
16	21.0	58	69.5
17	22.8	59	70.7
18	24.6	62	71.9
19	27.5	63	72.5
21	29.3	64	74.0
22	30.5	65	76.6
25	31.1	66	77.2
26	33.5	68	81.4
27	35.3	69	82.0
28	37.7	71	82.6
29	38.9	72	83.8
30	40.1	73	85.0
32	40.7	75	85.6
33	41.3	76	88.0
34	44.3	78	89.6
35	46.1	79	90.2
36	46.7	81	91.6
37	47.3	83	92.8
38	49.1	84	94.0
39	50.3	86	94.6
40	53.9	88	95.8
41	55.1	89	96.4
42	55.7	91	97.0
43	57.5	100	97.6

Mean 39.85
Standard Deviation 27.87

Table A-13

Tool Matching Speed Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	24	56.9
1	1.8	25	59.9
2	2.4	26	64.7
5	4.2	27	67.1
6	4.8	28	70.1
7	6.0	29	77.2
8	6.6	30	79.0
9	7.2	31	81.4
10	10.2	32	83.8
11	12.0	33	84.4
12	12.6	34	86.2
13	14.4	35	88.0
14	16.2	36	90.4
15	21.6	37	92.2
16	24.6	38	92.8
17	26.9	39	93.4
18	30.5	41	94.0
19	35.9	42	94.6
20	38.3	43	95.2
21	41.3	44	97.0
22	49.1	45	98.8
23	53.3	47	99.4

Mean 22.32
Standard Deviation 10.01

Table A-14

Tool Matching Right Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	20	54.5
1	3.0	21	57.5
2	4.8	22	61.1
3	5.4	23	65.9
4	6.0	24	70.1
5	7.2	25	72.5
6	7.8	26	77.2
7	9.6	27	81.4
8	12.0	28	84.4
9	13.8	29	87.4
10	16.8	30	88.6
11	21.6	31	89.8
12	23.4	32	92.8
13	25.1	33	94.0
14	31.1	35	95.2
15	33.5	36	95.8
16	38.9	37	96.4
17	44.3	38	97.6
18	47.9	39	98.2
19	50.9	40	98.8
		42	99.4

Mean 18.44
Standard Deviation 9.20

Table A-15

Tool Matching Wrong Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	10	89.2
1	25.1	12	90.4
2	42.5	13	93.4
3	53.9	14	94.6
4	61.1	15	95.2
5	69.5	16	96.4
6	75.4	17	97.0
7	81.4	19	97.6
8	85.0	20	98.2
9	86.8	23	98.8
		32	99.4

Mean 3.88
Standard Deviation 4.97

Table A-16

Tool Matching Accuracy Scores
Converted to Percentiles (N=167)

Score	Percentile Rank	Score	Percentile Rank
0	0.0	74	28.1
4	3.0	75	28.7
23	3.6	76	29.3
28	4.2	77	30.5
31	4.8	78	31.1
33	5.4	79	33.5
36	6.6	80	34.7
39	7.2	81	35.3
42	9.0	83	35.9
47	9.6	84	38.3
50	11.4	85	40.1
52	12.6	86	41.9
53	13.2	87	44.3
58	14.4	88	45.5
59	15.0	89	49.1
60	16.2	90	51.5
61	16.8	91	52.5
63	18.0	92	57.5
65	19.2	93	63.5
66	20.4	94	64.7
69	21.0	95	66.5
70	22.2	96	71.9
71	22.8	97	75.4
72	26.3	100	76.6

Mean 79.90
Standard Deviation 23.98

Table A-17

Intercorrelations of Raw, Speed and Accuracy Scores
for 167 Mentally Retarded Workshop Employees

Subtest:	Raw Scores [a] (1)	(2)	(3)	(4)	Speed Scores [b] (1)	(2)	(3)	(4)	Accuracy Scores [c] (1)	(2)	(3)	(4)	IQ [d]
Raw Scores													
1. Name Comparison													.48
2. Computation	.76												.55
3. Vocabulary	.71	.69											.62
4. Tool Matching	.72	.62	.55										.43
Speed Scores													
1. Name Comparison	.94	.67	.59	.68									.39
2. Computation	.61	.77	.50	.56	.63								.35
3. Vocabulary	.67	.58	.71	.57	.63	.58							.30
4. Tool Matching	.60	.47	.40	.87	.62	.59	.54						.26
Accuracy Scores													
1. Name Comparison	.60	.56	.56	.51	.39	.30	.37	.34					.47
2. Computation	.52	.65	.46	.43	.40	.21	.22	.20	.63				.48
3. Vocabulary	.35	.39	.66	.31	.23	.15	.17	.15	.53	.52			.52
4. Tool Matching	.45	.45	.41	.56	.37	.24	.27	.21	.54	.61	.44		.42

[a] Raw scores= number right

[b] Speed scores= number of items attempted

[c] Accuracy scores= number right/number attempted

[d] Highest recorded IQ, obtained for 122 individuals.